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The Journal of HEREDITY

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APRIL, 1924

ORIGIN OF THE SHEPHERD DOG
ANNE TRACY

A HARDY CHINESE BUSH CHERRY
GEORGE M. DARROW

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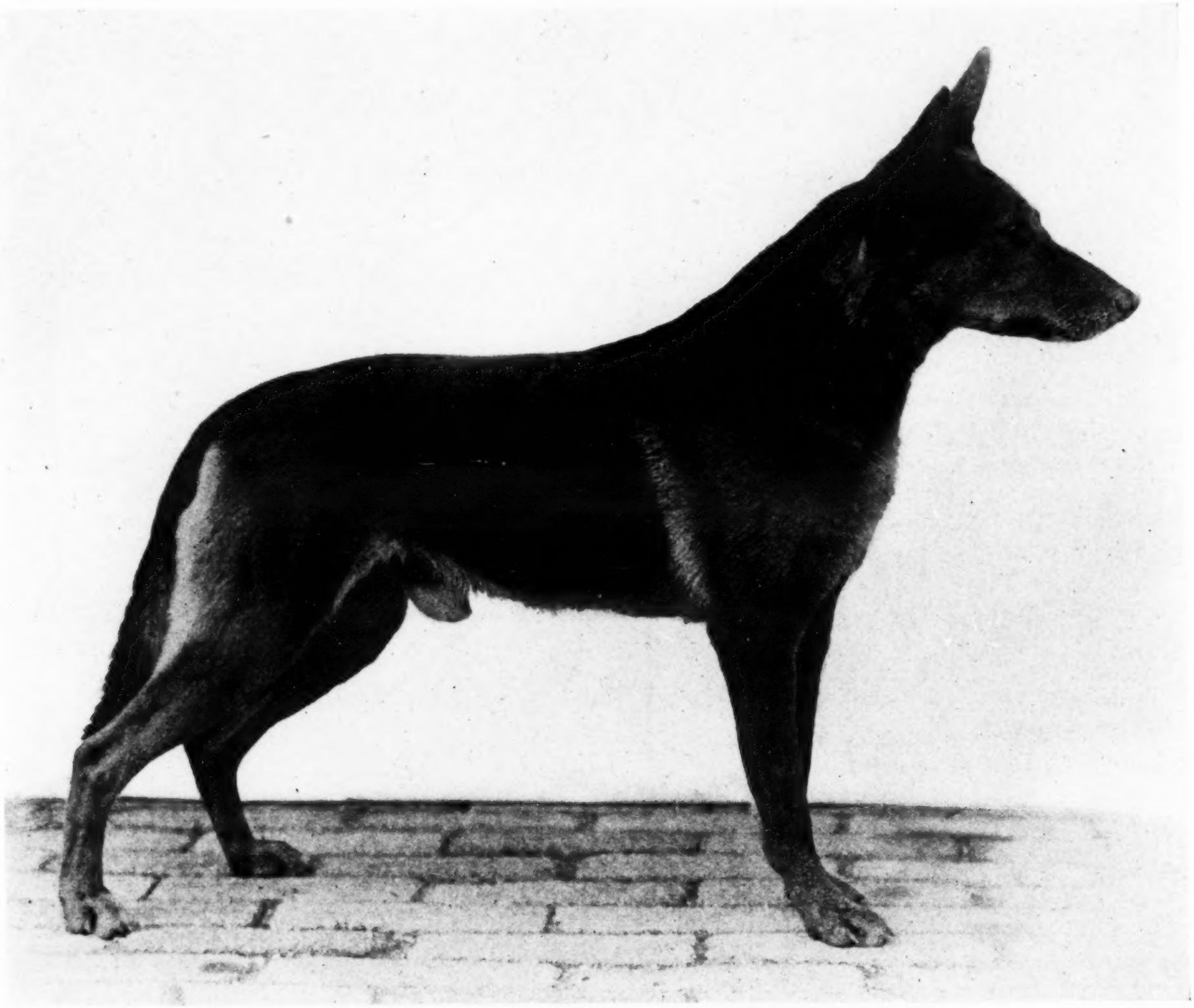
OVER A SIX-FOOT FENCE

Eric von Grafenwerth clearing a fence that few horses could negotiate. This is one of the more spectacular feats performed by Shepherd Dogs since they have become members of the police departments of many cities. These duties have earned them the popular name of "Police Dogs," although the breed is not a new one, and has been used in Europe for herding sheep for centuries. Neither has the breed been developed by a wolf-dog cross, as often stated. In fact, since the Bronze Age, or even earlier, it has been remarkably uniform, and shows no evidence of wolf admixture for thousands of years. (Frontispiece.)

THE ORIGIN OF THE SHEPHERD DOG

ANNE TRACY
Secretary and Treasurer, Shepherd Dog Club of America



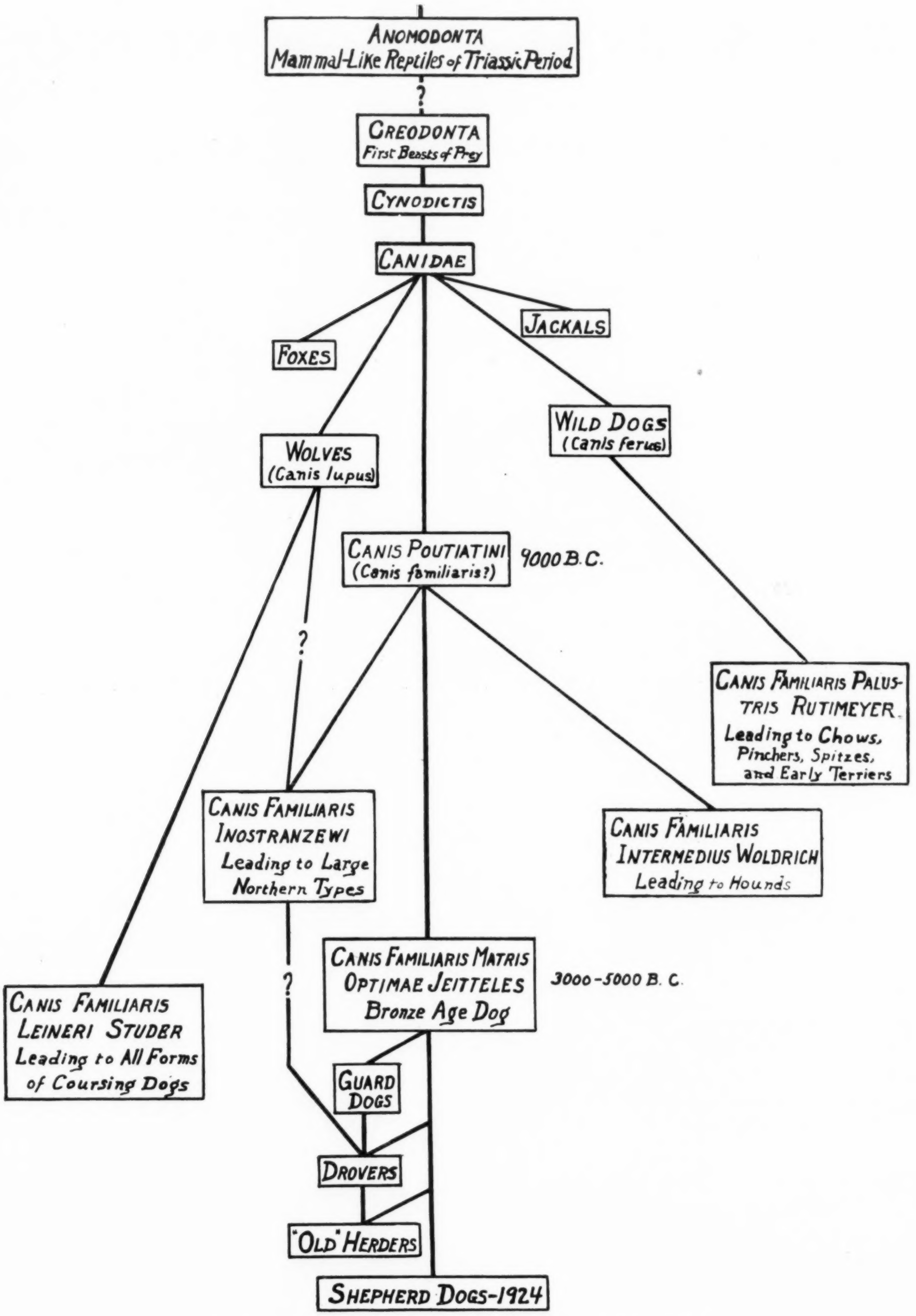
INTERNATIONAL CHAMPION APOLLO VON HUNENSTEIN

FIGURE 1. Shepherd Dogs have long been a utility breed, selected for their ability in herding their masters' flocks. When the German Shepherd Dog Club was organized in 1899, hard and fast rules regarding color and other fancy and non-essential "points" were not adopted, but endurance and intelligence were given first consideration.

THE German Shepherd dog has so many appellations that the general public is naturally confused as to its origin. The breed which the American Kennel Club in 1917 officially designated as the "Shepherd dog" is known in England as the "Alsatian Wolf Dog," and in France since the war as the "Alsatian Shepherd Dog," while it is everywhere popularly called a "Police Dog."

In reality, the Shepherd dog is the native sheepfolding dog of Germany.

It is perhaps beyond the scope of these pages to trace the descent of the canine race but a brief summary may prove enlightening.



FAMILY TREE OF THE SHEPHERD DOG

FIGURE 2. Note that the Shepherd Dog is not the product of a recent wolf-dog cross. The only connection, through *Canis inostranzewi,* is questionable, and goes back many thousands of years, at least.

C. Poutiatini | Bronze Age Dog | Shepherd Dog | Wolf

SKULLS OF DOG AND WOLF COMPARED

FIGURE 3. *Canis poutiatini* is the earliest of the true dogs of which we have knowledge, and his remains are found in deposits of the Stone Age. The remarkable similarity between the skulls of this Stone Age dog, the Bronze Age dog, and the Shepherd Dog, are taken by authorities as unquestionable proof of their close relationship. In fact, it is doubtful whether any other race has maintained its characteristics with such constancy over so long a period. The skull of the Polish wolf is not photographed in the same scale, but serves to show some of the striking morphological differences between the two species. From von Stephanitz' *Shaferhund in Wort und Bilt.*

The Ancestors of the Dog

The earliest known Carnivora, the Creodonta, were probably the primitive ancestors from which all dogs are indirectly descended. We first hear of them in the Eocene period. In the following Oliogocene there appeared the *Cyonodictis* which, through its descendant, the *Thephrocyon*, leads in the direction of the group Canis. In the Pliocene period the Fox (*Vulpes*) appeared and is, with the exception of the Canids of the middle Miocene the first true Canid recorded in Europe. Wolves did not appear until later.

Prof. H. F. Osborn tells us that Neolithic man had horses, sheep and dogs with him in Africa; while in Europe he had cattle, goats and pigs as well, and we know that man and *Canis lupus* are contemporaries in the American Pliocene period. We know also that with the exception of some islands there are few parts of the world where we cannot find evidence that dogs in some form existed as an aboriginal animal. We cannot but agree when C. Hamilton Smith says: "As the dog alone of all brute creation voluntarily associates himself with the conditions of man's existence, it is fair to presume also that he was the first of man's companions and that to his manifold good qualities the first hunters were indebted for their conquest and subjugation of other species."

Primitive man doubtless considered dogs from a purely utilitarian standpoint and by the process of elimination established strains adapted to his needs. The men of the Old Stone Age apparently had house dogs, probably as watch-dogs, for deposits in Denmark and Switzerland prove that dogs were already domestic animals in the Neolithic and Bronze ages. We can get an idea of the type of dog kept by the Neanderthal man from the picture of an *Icticyon rivcti*, the wild dog of Ecuador discovered by Trouessart, which probably bears a strong resemblance to his Neolithic prototype.

The earliest known remains of a true dog are those of the so-called *Canis poutiatini* which carry us back about 12,000 years to the Stone Age. Prof. Studer, of Bern, believes that this animal bridged the gap between a medium-sized *Canis lupus* (or perhaps a large wild dog, *Canis ferus*) and a true domestic dog, *Canis familiaris*. Whether the *Canis poutiatini* was in fact a *Canis familiaris* or a domesticated *Canis ferus* is still open to discussion. Danish deposits have yielded the bones of small domestic dogs that were contemporaries of the larger *Canis poutiatini*. At any rate, Studer considers *C. poutiatini* the progenitor of all herding and hunting dogs and gives five distinct types as the primitive ancestors of the modern dog, classified as follows:

1. *Canis familiaris Palustris* Rutimeyer, the small house dog of the Pile Dwellers who flourished in the Stone Age about 10,000 years ago. He is probably the direct descendent of a small wild dog, *Canis ferus mikii* Woldrich, a contemporary of the *Canis lupus* and co-descendant of the first true Canidae.

His descendants may be seen today in the Bismark archipelago, in Siberia as the Tungus dog, and in Sumatra as the Batta spitz in almost unchanged form. The chows, spitzes, pinchers and terriers were probably derived from him, as well as the smaller types of northern sporting dogs.

2. *Canis familiaris Leineri Studer*, from which the discoverer derives the coursing dogs, inclusive of the greyhound in all its forms, and the stag, deer, and wolf hounds.

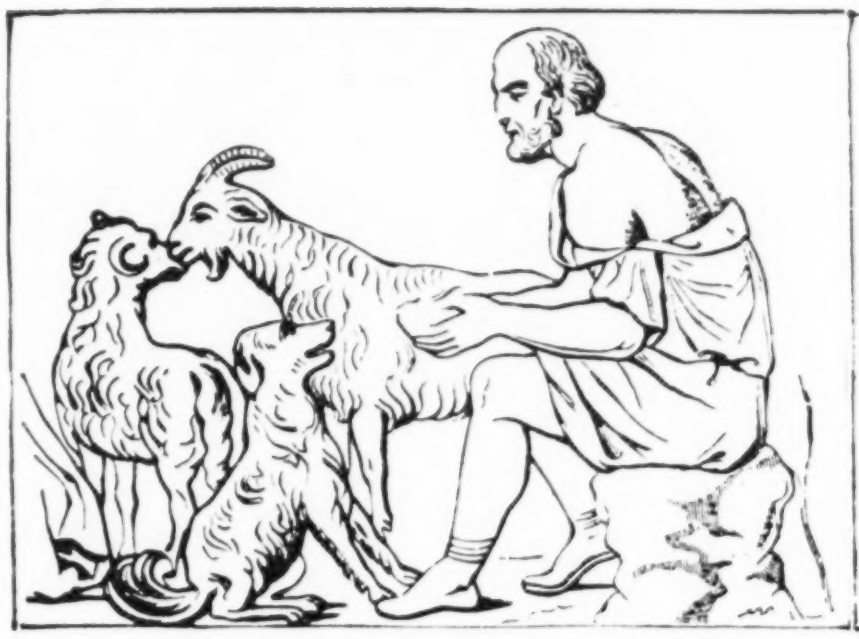
3. *Canis familiaris intermedius* Woldrich, a direct descendant of *Canis poutiatini* and the progenitor of our modern hounds. The oldest Swiss and French types of hounds may give some idea of its appearance.

4. *Canis familiaris inostranzewi* Anutschin. The oldest deposits indicate this dog's existence in the early part of the later Stone Age, and certainly later than *Canis poutiatini*, from which it is also directly descended. The earliest bones found would seem to indicate that an admixture of wolf blood had taken place, and it is not unlikely that man, at that period, had found it advisable to increase the ferocity and size of his watch dogs. Later deposits show the same dog in existence during the Iron Age about 2,500 years ago.

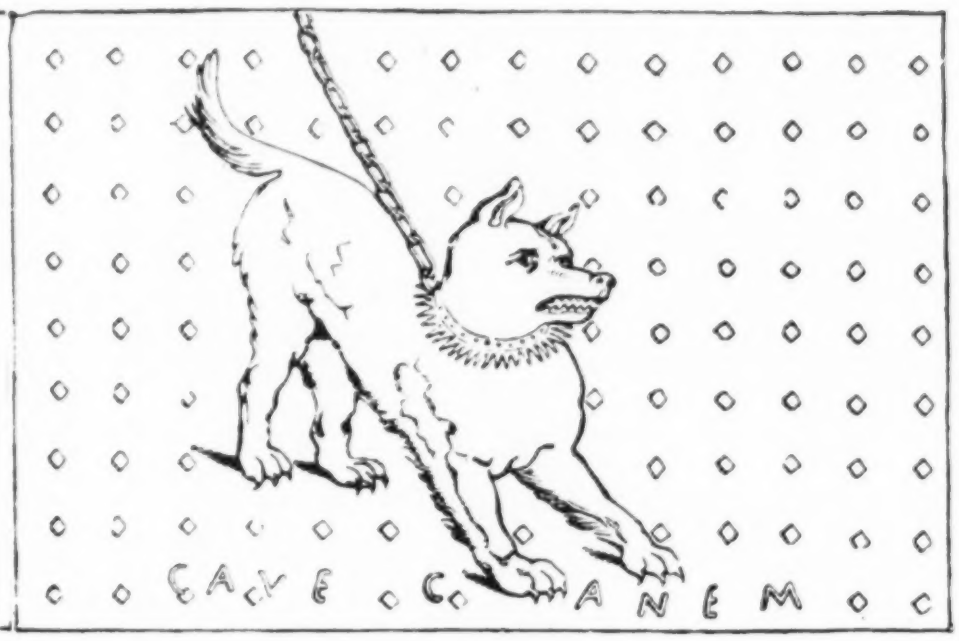
Canis inostranzewi is undoubtedly the progenitor of the large northern types that are used for hunting big game or as watch-dogs, sledge-dogs and reindeer herders, such as the Laiki, Elkhounds, and Eskimo dogs. Besides these northern types, *Canis inostranzewi* is considered as the progenitor of the Continental herding or driving dogs, the Matins of France, the Mastino of Italy, and probably the mastiffs of England. Perhaps these drovers are the result of a cross between the Inostranzewi type and the Bronze Age dog. Doubtless they are closely related to the Newfoundland, the Swiss Sennenhund and its later perfected offspring, the St. Bernard. Poodles may also have been derived from the Drover strain combined with that of the hunting dogs of the Middle Ages. C. Hamilton Smith tells us that the "Northern invaders of the Roman empire brought fierce races of rugged and huge coursing and cattle dogs whose descendants may still be traced in Russia, Scotland, Ireland, Spain, and even in America."

5. *Canis familiaris matris optimae* Jeitteles, the "dog of the Bronze Age" as he is called from the period of the deposits with which his bones have most frequently been found.

The first deposits of that period were found in Bohemia, Pomerania and Bavaria and later other deposits were found in Switzerland, Italy, Holland, and Ireland. Those in the marshes of Northern Holland and Frisia are particularly interesting as they yield evidence of uninterrupted habitation from the days of the Pile Dwellers down to our own middle ages. Another im-



Grecian Shepherd With Dog



Roman Watch Dog

DOGS OF THE ANCIENTS

FIGURE 4. The Greek dog looks not unlike a modern Collie, and his resemblance to the "Coleys" portrayed by seventeenth century artists is even more striking. The Roman watch-dog might be compared with early drawings of Mastiffs—relatives of the French Matin and the Italian Mastino. From von Stephanitz' *Shaferhund in Wort und Bilt.*

portant deposit shows us the same dog in the oasis of Anan, near Askabad, east of the Caspian sea, and dating back some 8,000 years.

A significant fact is that everywhere the appearance of the Bronze Age dog is coincident with the development of the sheep industry and often heralds the appearance of a new breed of sheep. It is evident that his existance has been connected with flocks and herds since the earliest days, although probably not so much as a herder as charged with guarding his master's riches.

This seems the most logical explanation of the extensive area inhabited by these dogs and of the close resemblance the various European types of shepherd dogs bear to each other. They are all descendants of the Bronze Age dog, and through it of *Canis poutiatini.*

Studer writes: "It is doubtful whether any other race has retained its characteristics with such constancy. The Roman excavations at Koenigsfelden show us this continuity of form from the very earliest times to the present day."

A study of the skulls of *Canis poutiatini*, the Bronze Age dog, and the German shepherd dog have proved the relationship beyond doubt. Buffon considered the shepherd's dog as the original species from which all the others had sprung, and Count Henri de Bylant bears witness to the fact that the German, Belgian, and Dutch shepherd dogs are of the same race, as he advocates calling them "Continental shepherd dogs."

Types of Shepherd Dogs

As civilization developed flocks and herds increased and with them the need for protection against marauders. Wolves were not exterminated in France until 1838 and during the Napoleonic wars had become so bold in the vicinity of Vienna that they would attack men.

The work of dogs with sheep has, in the course of history, been threefold. At first it was guarding, that is, protecting the flock against attack by beasts or men. Then it became driving, keeping the flock together on its way from pen to pasture, collecting the strays and finding the lost lambs. Later it developed into herding, which, as it is practiced now, means, protecting the fields that are planted, driving the flock across the narrow bridges and through the gateways of a modern village and, in fact, doing all the work that formerly was done by men.

Years ago a shepherd led his sheep, his men doing the driving and herding,

DOGS OF THE MIDDLE AGES

FIGURE 5. A sheepfold attacked by wolves, and a boar hunt, as seen by mediaeval artists. Note the two types of dogs used for hunting—attackers and coursers. These illustrations and those in Figure 4 show clearly the types of dogs required at various times and their fundamental similitude, the chief variations being in weight, size, and quality of coat.

and holding the dogs in leash until danger threatened. While the sheep rested the watch-dogs lay on guard around the flock. In those days drovers and herd dogs had long or short tails, smooth or shaggy coats, hanging or prick ears; it mattered little, provided their mental calibre and body conformation were true to the most useful type.

There are many old pictures and prints dating from the twelfth to the eighteenth centuries, showing dogs at work with thir charges or attacking their hereditary enemy, the wolf, and in some it is particularly easy to recognize the strains which we know today as the "Old English," "Old French," and "Old German" sheep dogs, with their shaggy coats and hanging ears. Books and manuscripts of the same period and dealing with rural life abound in references to the two types of dog necessary to the protection and well-being of a man and his possessions. These two types vary only in size, the larger being used to fight predatory animals and the smaller to arouse the household and attack a possible invader.

The use of dogs for driving developed very gradually as bears and wolves were exterminated and shepherds found that dogs could be useful in other ways. Moreover, as the heavier dogs were more or less rough with their charges, a lighter and more active animal began to take his place while the drover took up the duties of guardian to hearth and home. Today the so-called herd dogs of Russia, Poland and the various Central European countries, as well as those of Turkey and the Caucasus are primarily watch-dogs. Driving and herding is done by the shepherd while the dogs guard the flock at night. The Bouvier de Flandres and the "Toucheur de Boeuf" are modern western European types of drovers, though these heavier dogs rarely work with sheep and, except in outlying districts or in the mountains, are more often used as watch-dogs.

Von Stephanitz, the greatest living authority on German shepherd dogs, considers these various local types of driving and herding dogs as collateral and inter-bred descendants of the Bronze Age dog and in some countries as the result of an early cross between *Canis inostranzewi* and the Bronze Age dog.

Not until the eighteenth century, when German agriculture was once more in full swing after the Thirty Years War, did actual herding, in the modern sense, become a necessity. It was as slow and as localized a process

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STONIHURST BERO PROTECTING HIS MISTRESS

FIGURE 6. The Shepherd Dog, when trained for police duty, is taught to protect his master without command and to desist from attack at a word from his master.

as the gradual development from watch-dogs to drovers had been. To this day, in those districts where wolves and bears were last seen or where settlements are sparse and the areas under intensive cultivation smaller and more widely scattered, the older type is still in common use. In other districts, however, where sheep graze all the year round, where the grazing ground may be a field just harvested, the grass-grown edges of the highways or any unfenced bit of land bordering on a stand of wheat or other valuable crop, herding requires great intelligence and unlimited endurance on the part of the dog. The larger, heavier types heretofore in general use had to give way to a smaller, better adapted dog. The natural result was the utilization of the house and watch dog which had undoubtedly already assisted in the work of the drovers. It only became necessary to intensify the innate desire to travel in circles which all true shepherd dogs have, to subdue the instinct to bark which had become part of the watch dog's duties and to improve and fix the grip of the dogs on the sheep. In regard to this last, each district had its own pet theories depending largely on the breed of sheep that were raised.

The shepherd dog now found in Germany, is the native dog best adapted to that service, the dog that for hundreds of years earned his keep by protecting his master and his master's possessions, the descendant in straight line from the dog of the Bronze Age and who, during the centuries when watch dogs and drovers went with the herds to pasture, kept his natural instincts alive as the guardian of his master's house and barns.

This theory is borne out by the bones found in the Steinauer cave in Hessen-Nassau. When in 1540 Count Hanau rebuilt his Castle Steinau, the burial place of the hunting and watch-dogs of the Castle, which had been in use since the thirteenth century, was disturbed and the bones thrown into the cave. Dr. Hilzheimer, who examined the remains with great care found the larger proportion to be of hounds and other hunting dogs, but he found also a large number of skulls identical with those of the Bronze Age dog and of our modern shepherd dog. These skulls cover a period from the beginning of the thirteenth to the beginning of the nineteenth centuries, and Dr. Hilzheimer explains this by the statement that these dogs were kept by the castle staff as watch dogs and sometimes for hunting as well.

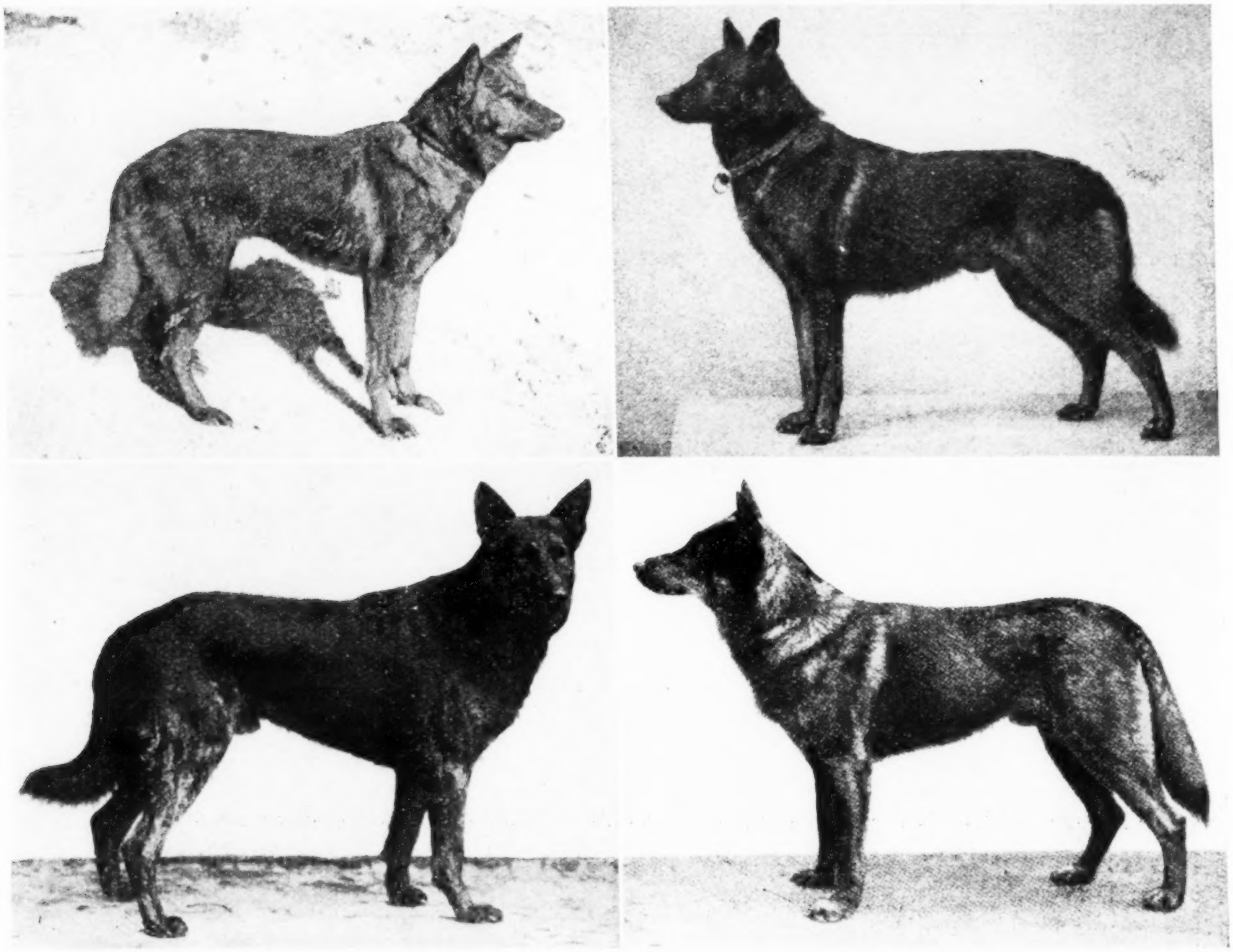
This, then, is the origin of the German shepherd dog. He is simply a direct and pure-blooded descendant of the earliest known continental shepherd dog. Since sheep raising was first carried on, his progenitors did their part in guarding, driving, and herding, and, being bred purely for use, he has retained most of the characteristics of his primitive antecedents.

Societies for the pure-breeding of animals are a comparatively modern institution and England here led the way. The Collie Club was founded in 1880 to promote the pure breeding of the Scotch shepherd and at that time the "southern sheep dog," or smooth-coated collie, was a frequent sight. Sometimes both rough and smooth-coated whelps would appear in the same litter. In 1888 the Old English Sheep Dog Club was founded to foster interest in the shaggy, bob-tailed English herder, but it was not until 1891 that a club was founded in Germany under the leadership of Count Hahn, Capt. Riechelman, and the artist, L. Reckman. It only lived three years but on April twenty-ninth, 1899, the Verein fur Deutsch Schaferhunde was founded with its headquarters at Stuttgart.

In the early days of the organization the shepherd dogs in use throughout Germany were as dissimilar as in any other country where utility breeding had been influenced chiefly by the local breed of sheep, or climate, topography, and so forth. In some districts the large "Old German" were more popular; in others a little dog resembling

Horand Von Grafrath

Hektor Von Schwaben



Beowulf

Dewet Barbarossa

FAMOUS FOUNDERS OF THE BREED

FIGURE 7. For the pedigrees of these dogs, see Figure 9. Horand von Grafrath appears among the ancestors of practically every field champion and may be regarded as the foundation sire of the breed. He is the first dog entered in the stud book of the German Shepherd Dog Club, founded in 1899. From von Stephanitz' *Shaferhund in Wort und Bilt.*

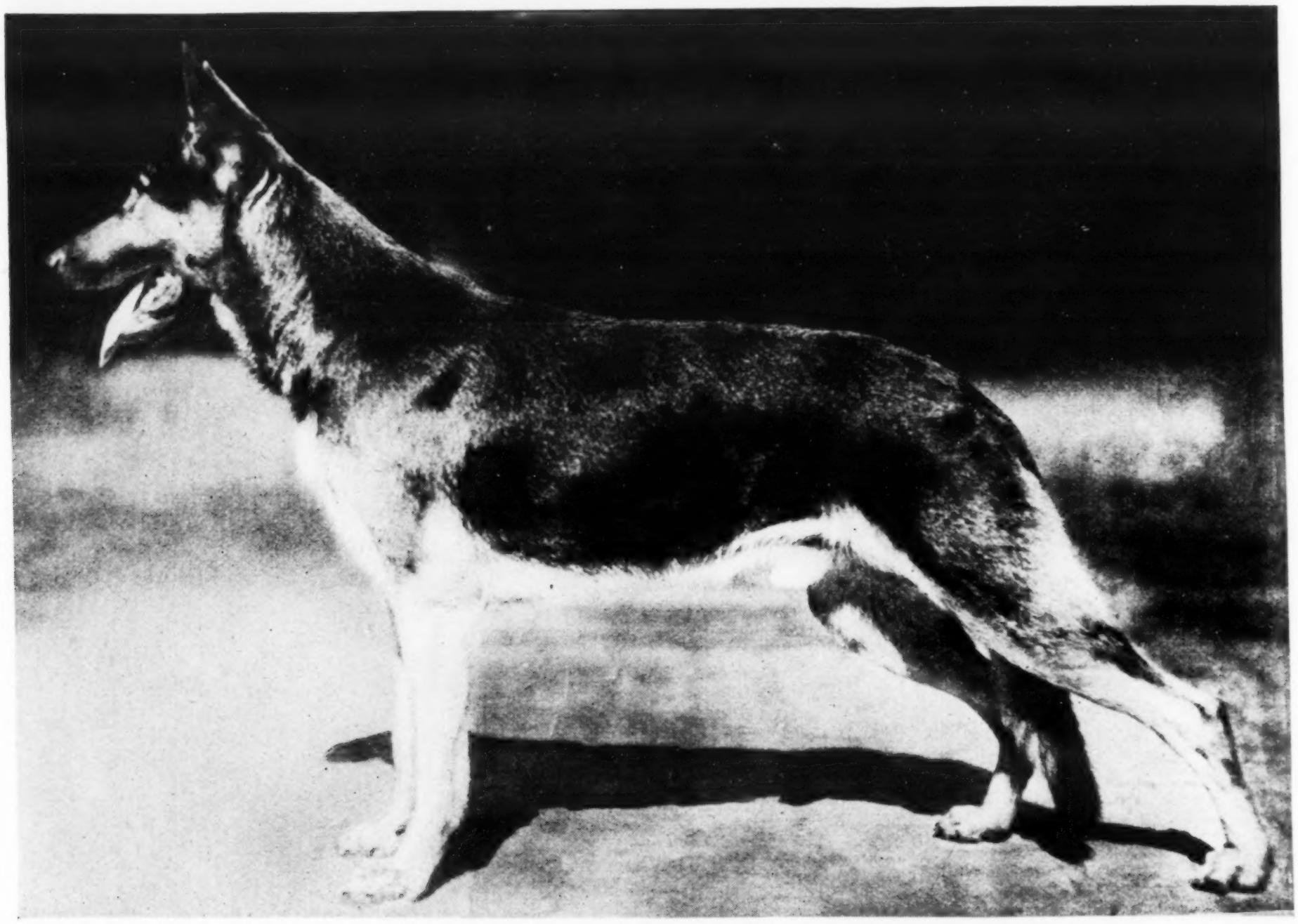
the Welsh sheep dog of today in size and coat. In the North there was a tendency toward ring-tails and wooly coats; in the South toward heavy heads and tulip ears, while the coloring was as varied as it is today.

The SV, as the German Verein is abbreviated, had to fix a standard and by careful combination and selection try to define the type of dog most useful to the sheep industry. Its object, the breeding of a *utility* dog, has been crowned with success, for there is no other breed in the world so generally used for so many different purposes.

Capt. von Stephanitz has described in his book "The Shepherd Dog in Word and Picture" how the first carefully selected matings influenced the breed.

Early History of the Breed

Horand von Grafrath, SZ 1, measured about sixty-one centimeters at the withers, was a well built and proportioned dog, full of temperament, a real shepherd and an all-important sire. He figures in the pedigree of practically every field champion. He was bred by the Sparwasser kennel in Frankfurt and produced his most famous son, Champion in 1900-01, Hector von Schwaben SZ 13, out of a Wurtemberg working bitch, Mores Plieningen. A daughter of Horand's, Thekla 1, out of Mme. von der Krone, another Wurtemberg



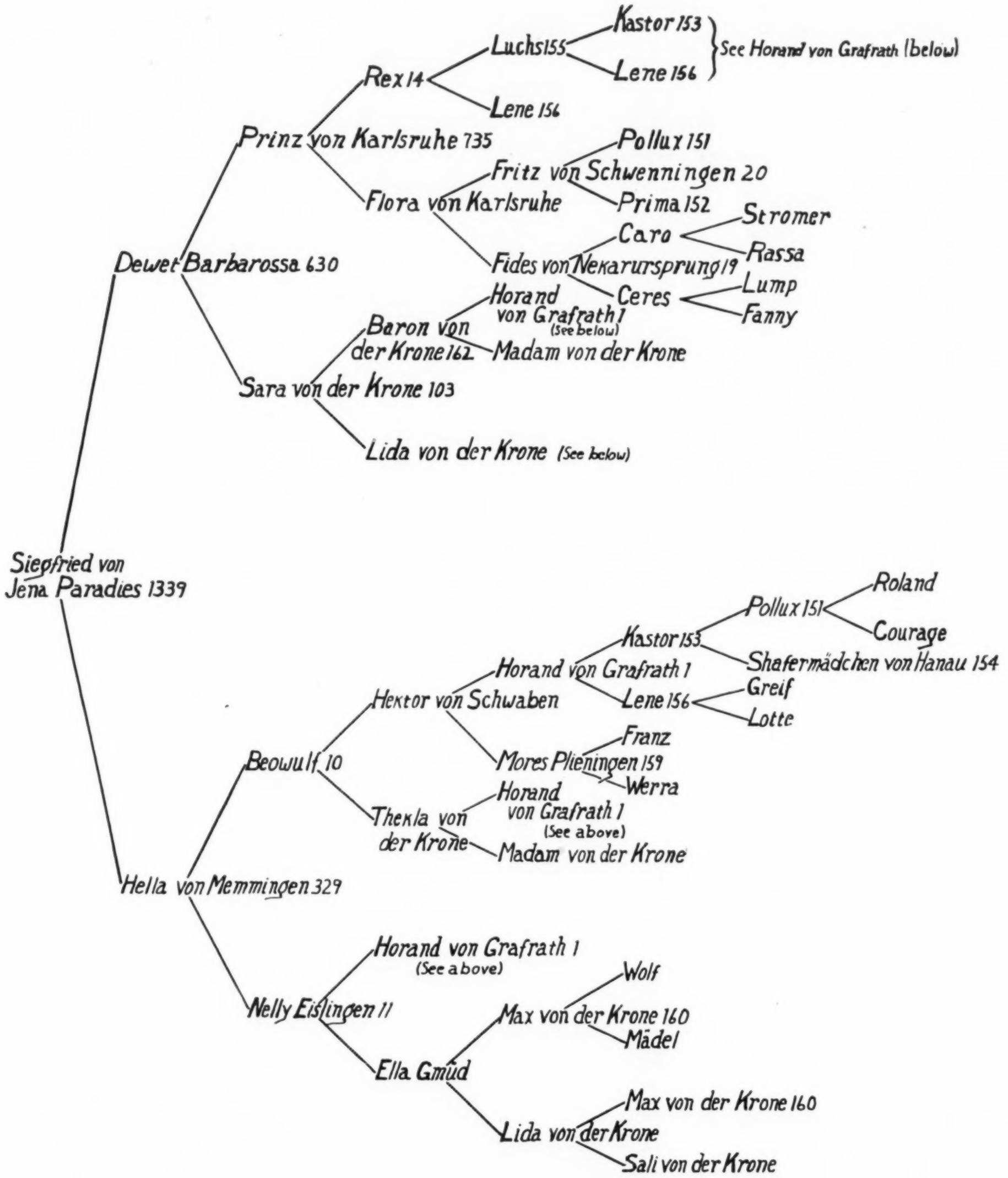
CITO BERGERLUST

Figure 8. German champion of the breed in 1922-23.

bred working bitch, mated to her half brother, Hector, produced the famous sire, Beowulf 10, without whom no pedigree is really complete. Another son of Hector, Champion in 1903, Roland von Park 245, was out of Flora, who (by Fritz von Schwenningen, out of the working bitch Schwabenmadle von Grafrath), was on her sire's side of the same blood lines as Horand. Roland von Park, beside having made a remarkable show record, figures as a potent ancestor of the 1910 Champion, Tell von der Kriminalpolizei.

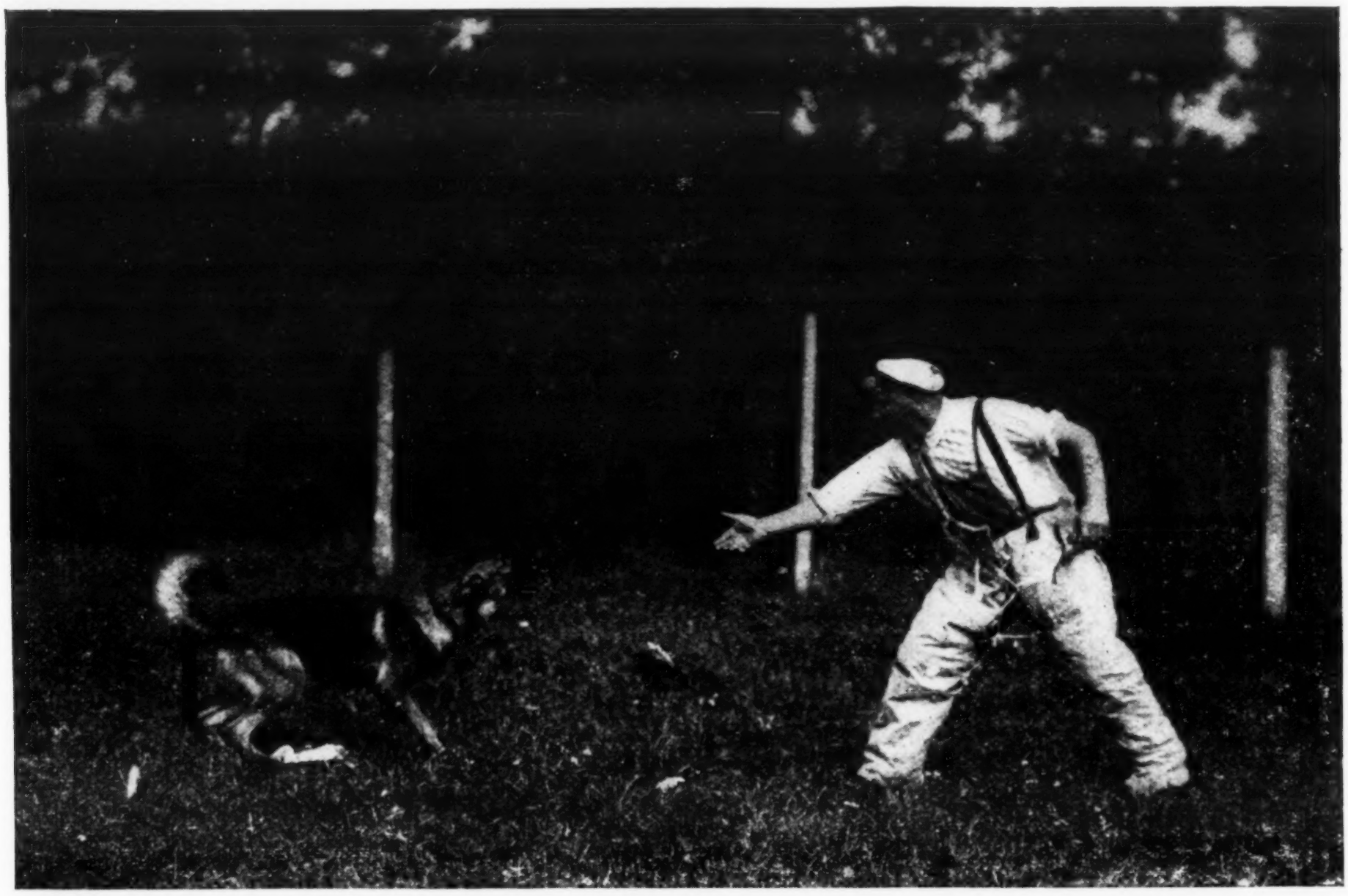
Horand's litter brother, Luchs Sparwasser is the sire of Rex 14, whose two sons, Rex and Prinz von Karlsruhe, are the founders of the Dewet line. . Dewet Barbarossa was by Prinz, out of a granddaughter of Horand, and when mated to the closely related Hella von Memmingen, Champion 1902-03 (Hella was by Beowulf out of Nelly Eislingen, daughter of Horand), resulted in the great Field Champion 1906, Siegfried von Jena Paradies. Another great son of Hella's was the 1911 Champion, Norbert von Kohlwald, who, on his sire's side, was Horand bred.

Another important Horand line comes down through Beowulf's litter brother, Pilot III, to Graf Eberhard von Hohenesp whose dam was by Hector von Schwaben. Graf Eberhard sired Munko von Boll and also, mated to Minka Barbarossa, produced the 1908 Champion, Luchs von Kalsmunt Wetzlar, who in turn sired both the 1910 Champions, Tell and Flora Kriminalpolizei. The present Kriminalpolizei strain, however, shows the addition of a related bloodline, that of the 1906-07 Champion, Roland von Starkenburg. Roland is the grandson of Hector von Schwaben on one side and of Beowulf on the other, while the



PEDIGREE OF EARLY SHEPHERD DOGS

FIGURE 9. Siegfried von Jena Paradies is considered one of the outstanding dogs of the breed and was field champion in 1906. This also gives the complete pedigrees of Dewet Barbarossa, Beowulf, and Horand von Grafrath, as far as known. The lines all trace back to "working dogs," that is, dogs actually used in sheep herding in Germany, and many of the registered dogs are still used for this purpose. Note that Horand von Grafrath appears four times in the ancestry of Siegfried, and twice as Beowulf's grandsire. According to Wright's Coefficient of Inbreeding (See *Journal of Heredity* for November, 1923), Siegfried is 10 per cent inbred, and Beowulf 12.5 per cent.



GUARDING AN OBJECT

FIGURE 10. The superior intelligence of Shepherd Dogs has caused their adoption for police work in many cities. This relatively new and more spectacular service has resulted in the breed's being known as the "Police Dog." It is to hoped that the rising popularity of Shepherd Dogs will not result in reducing the rigorous selection for endurance and intelligence that makes these dogs of great usefulness in many ways.

granddam on both sides was a Horand-bred bitch.

Roland, mated to the 1906 Champion, Gretel Uckermarck, a daughter of Beowulf and a Wurtemberg-bred bitch, produced the 1909 Champion, Hettel Uckermarck. The Boll strain, starting with Munko von Boll, is a strong Horand strain of working dogs and resulted in the Field Champion of 1912, Debora von Sehningen, whose dam was also of the Horand working strain.

The national and international champions of today are all combinations of these various Horand strains with very rarely an unrelated cross unless it be of a working line.

The French-American Champion, Apollo von Hunenstein, is on his sire's side a great grandson of Beowulf 10 and of Roland von Starkenburg, and on his dam's side both granddams were out of Beowulf granddaughters by herding stock.

The 1919 Champion of Germany—Dolf von Dusternbrook, is on his dam's side a grandson of Apollo's out of Flora Berkemeyer, the founder of the Riedekenburg strain (Flora's sire's sire was by Roland von Starkenburg out of a daughter of Beowulf and Nelly Eislingen). On his sire's side, Dolf is a double great grandson of Hettel Ukermark. Alex von West-Falenheim, who sired both the champions, Anni von Humboldpark and Erich von Grafenwerth, was by Hettel Ukermark out of a half sister of Appollo's and on his dam's side goes back to Milan von der Krone of the original Wurtemberg working stock.

Cito von Bergerslust, the 1922 and 1923 German champion, is, on his sire's

SHELTERS FOR RED CROSS DOGS

FIGURE 11. The shelters were bomb-proof, and as comfortable as possible. In the early months of the European War, dogs were used principally by the Red Cross, but the field of their usefulness grew rapidly as their abilities were recognized.

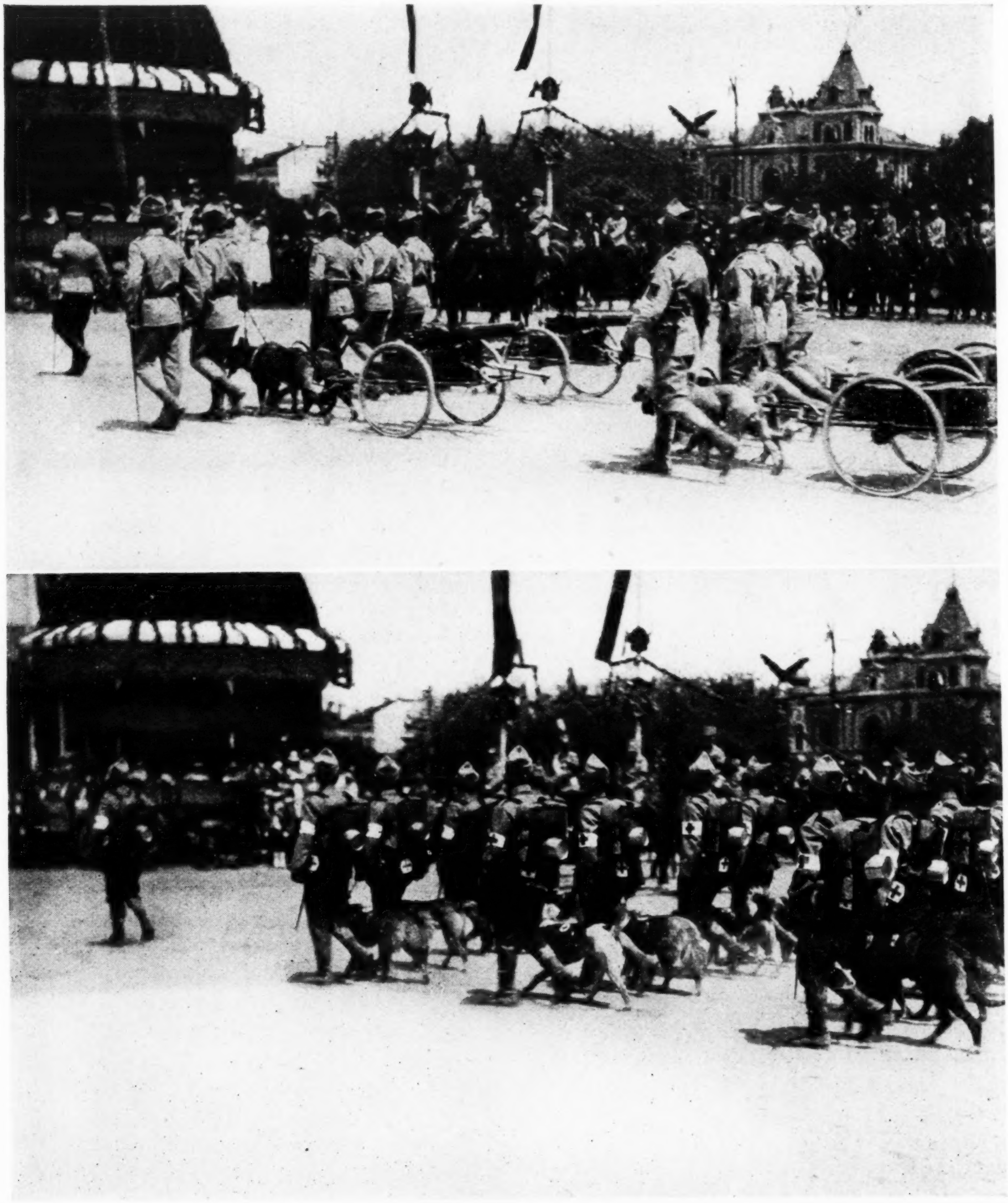
side, a great grandson of Flora Berkemeyer and Kuno Edelweiss (a grandson of Beowulf and of Roland von Starkenburg)—and also in that same generation of Billo Riedekenburg (by Hettel out of Flora Berkemeyer) mated to a granddaughter of Roland von Starkenburg. Cito's dam is a daughter of Alex Westfalenheim out of another double Hettel Ukermark cross.

The Shepherd Dog Not the Product of a Wolf-Dog Cross

There is a legend that these dogs are the product of a wolf-dog cross. Nothing, however, could be further from the truth. It is the height of unreasonableness to suppose that the get or great-get of a wolf can be a reliable sheep-herder, yet, as has been shown, the pillars of the breed were almost all working dogs. Many scientists have, in the past, endeavored to cross the various Canidae, but the result has always been the same; a hybrid curiosity, lacking the good qualities of either parent and fit only for confinement in a zoo. Such hybrids, according to Mivart, have been proved fertile *inter se*, though for no long period, and Buffon, although he had bred four generations of such hybrids, states that they never would domesticate. His experiments and experiences have been repeated time after time.

While there is great similarity of osteology between the two canids, wolf and dog, there are several radical differences. The most convincing to a lay student is in the tracks. The two middle claws in that of the wolf are close together and in the dog's are separated. The wolf's claws go deeper and the impression is more hairy. The imprint is longer and narrower and the ball of the foot more prominent.

If we go back and study the history of the various civilizations of the world, at no time do we ever find the names used for dogs confounded with those used for the wolf, and a thorough philological study would assuredly show that in no language and at no period did man positively confound the wolf, jackal or fox with a real dog. One has always been a menace to man's



DOGS WITH THE ROUMANIAN ARMY

FIGURE 12. This shows two of the ways dogs were used in wartime—harnessed to machine guns, and with the stretcher bearers. Official photograph, 1916.

GAS MASKS FOR WAR DOGS

FIGURE 13. Dogs were used in the French army for carrying messages and information between isolated points and to the rear, for hauling light carts near the front, and for ambulance work. When gas was adopted as a weapon, the dogs were taught to wear masks, and, thus equipped, they carried on their work in complete indifference to the poisonous fumes. French official photograph, 1916.

flocks and the other has for just as long a period been a domestic and eminently useful animal.

The few foreign breeders and dealers who advertized their stock as carrying wolf blood did so either from ignorance or from a misguided, but, alas, well-founded idea that it would increase the interest of the lay fancier and thereby the financial value of his dogs. No authenticated case is on record and no dog registered in the German studbook can be traced back to a wolf.

The standard as fixed by the German Club and adopted by the Shepherd Dog Club of America, Inc., is based on scientific observations of the demands made on a herding dog. An animal working all day long with sheep must have an indefatigable trotting gait; hence the required proportion of height to length of body (8 or 9:10), the absolute necessity for good angulation of the quarters and a strong back. The length of a dog's stride is determined by the angulation of the shoulders, but the strength of the forward momentum is determined by the backward shove of the hind-quarters.

The endurance of a dog will depend:

First—on the minimum of strain on the back required to co-ordinate the action of the fore and hind quarters and on the power of the back to transmit the forward momentum from the rear to the front.

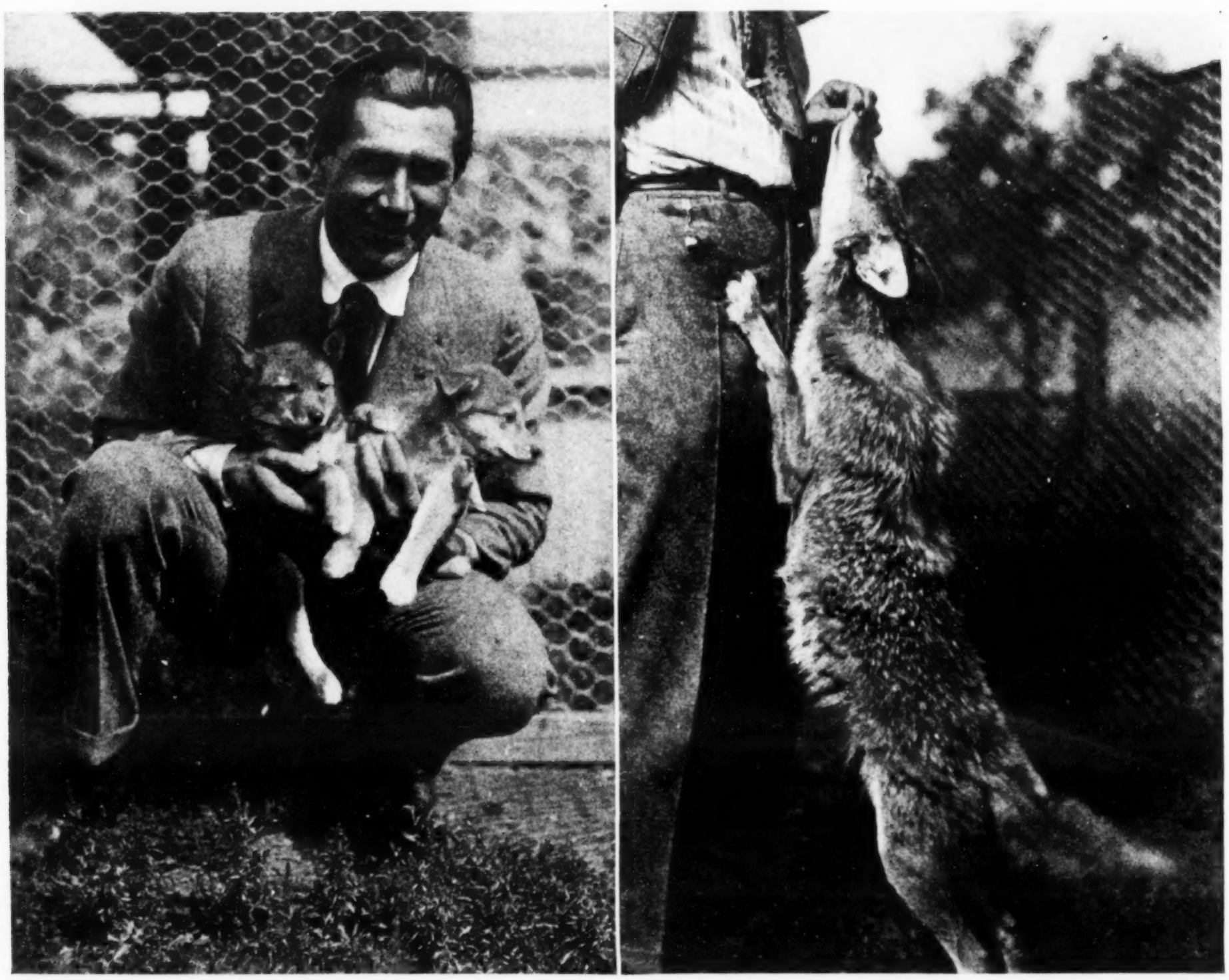
Second—Heart and lung capacity which means depth of chest and length of ribbing.

Third—Strength and elasticity of pasterns and feet.

Fourth, but not least—the dog's character and intelligence, for no dog, however perfect physically will, if he lack grit and brains, do as much as one who has.

The Utility Standard

Unfortunately our conception of pure breeding has proven a detriment to every breed of dog unless it was based on a rigorously applied utility standard. A prize-winning Collie and Old English sheep dog would hardly know what to do with a flock of sheep



MOTHER COYOTE AND HALF-BREED PUPS

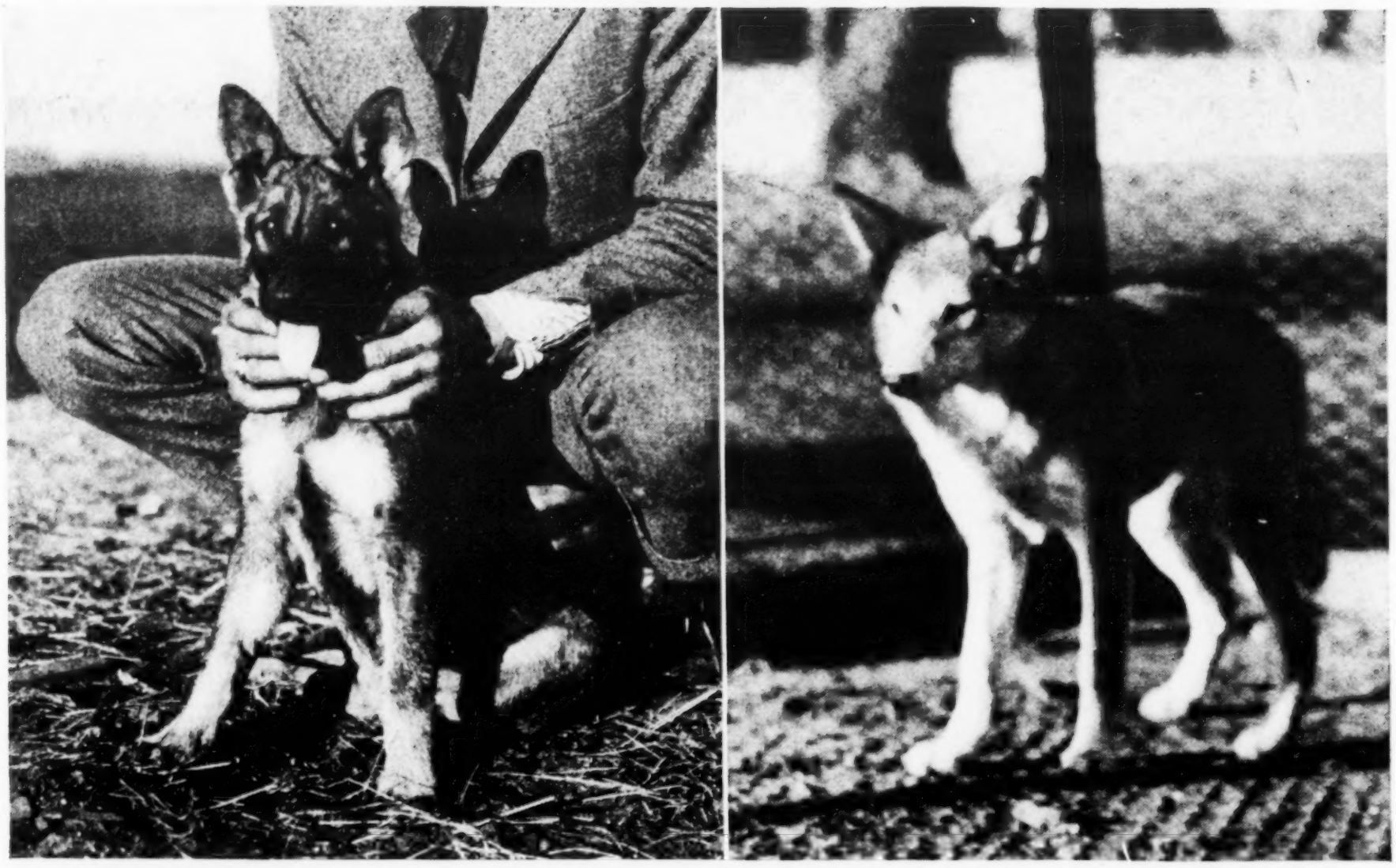
FIGURE 14. At the Rest Island Silver Fox Farm, Lake City, Minnesota, the experiment of crossing a coyote and Shepherd Dog was tried recently. A female Minnesota coyote had been captured some time previously and had become quite tame. She was mated with a full-blooded Shepherd Dog, and on March 22, 1922, four pups were born. All of them lived and two of them are shown at the left. Photograph by Frank G. Ashbrook, U. S. Biological Survey.

except, perhaps, to run or worry them for fun. The average terrier or dachshund at a show would be incapable of hunting unless for their own distraction. For generations they have been bred to the ignoble life of a show dog and as the pampered pets of thoughtless children or childless women.

There is, of course, great danger of the German shepherd degenerating in the same way, but it is to be hoped that breeders, in their efforts to supply the ever-increasing demand for this utility dog will not lose sight of the qualities that make him valuable to his owners.

In addition to their instinctive aptitude for herding stock of all kinds, shepherd dogs have become the war dogs and police dogs of Europe and far outnumber their competitors of all other breeds put together. With the armies their activities are fourfold; as courier dogs, with the sanitary sections, on listening post and patrol duty, and as draft animals.

Courier dogs have one advantage over their smaller and swifter rivals, the carrier pigeons, in that they can be sent in both directions, from rear to front as well as from front to rear and they are so much swifter and so much less visible a target than men that a courier dog's life is calculated as just

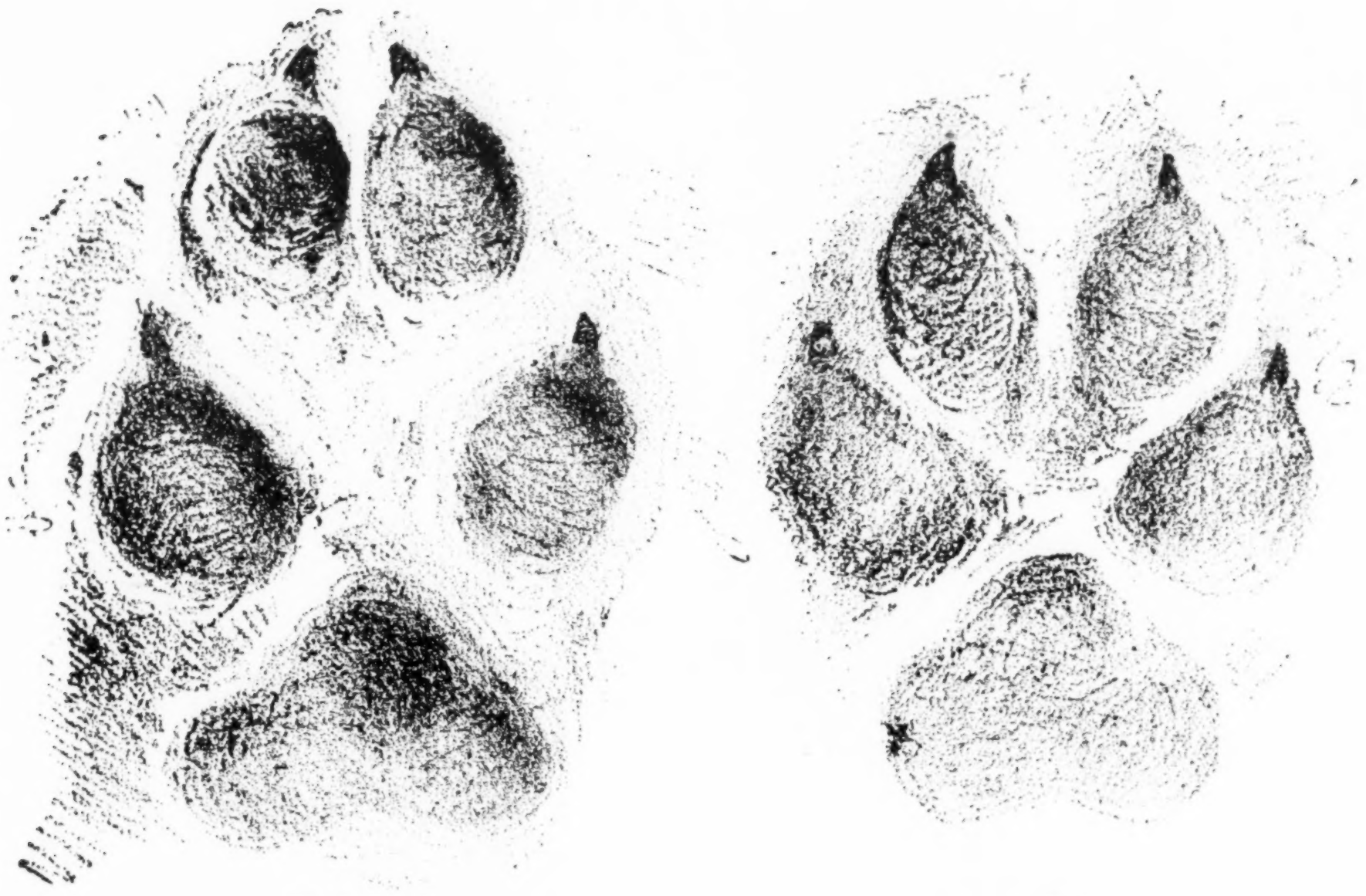


COYOTE-SHEPHERD DOG PUP COMPARED WITH SHEPHERD DOG

FIGURE 15. Both the pups are six months old. At this age the half-breed pups were much wilder than their mother. They killed chickens and committed other depredations at every opportunity. Note that the half-breed pup also resembles a coyote much more closely in outward appearance than he does a Shepherd Dog. Crossing dogs and wolves has been tried a number of times, but nothing has been gained by doing so. Photograph by Frank G. Ashbrook.

COYOTE AND TIMBER WOLF

FIGURE 16. The "points" of these wild relatives of the dog can be compared with those of the Shepherd Dogs shown in Figures 7 and 8. In some respects the timber wolf appears to resemble the Shepherd Dog more closely than the European wolves do. This is said to be true of the foot-prints (See Figure 17). Photograph by Frank G. Ashbrook.



Wolf Dog

FOOTPRINTS OF SHEPHERD DOG AND EUROPEAN WOLF

FIGURE 17. Note especially the differences in the position of the middle toes.

five times that of a soldier on a similar duty.

The work of dogs on duty with stretcher bearers has been particularly valuable, because of their tireless energy in searching for and finding the severely wounded who, having crawled under some shelter or lying half buried under earth or debris, are still alive but unable to make themselves heard or seen. The unerring power of the dogs to detect the living from among the apparently dead has saved innumerable lives.

The usefulness of dogs on listening posts and with patrols depends largely on the terrain. Their remarkably acute hearing has often detected sapping operations days before men would have noticed the sounds and the dog accompanying a scouting party has frequently signalled the proximity of the enemy when the men would have known it only after capture or destruction.

As draft animals they proved invaluable assets not only as food and mail carriers but in supplying ammunition to the front line. Their little carts were able to travel over stretches quite impassable to horses and mules, and when the wheels could no longer turn they were unharnessed and used as pack animals—one man with a string of dogs thus being able to supply a much greater amount of ammunition and at a much smaller risk of human life than would otherwise be possible.

As police dogs their duties have been twofold: protective and detective.

The protective training requires the dog to be absolutely obedient; and obedience in a police dog means to sit, lie down, heel, give tongue, climb a six-foot wall, stay in a given place until called off, retrieve, and to refuse all food offered by strangers. In addition to this obedience training, the dog must be gun sure and know when and how to arrest a given person, to protect his master without command and, above all, to desist from attack upon

command even when within three feet of his quarry.

The detective training includes the obedience and protective work with the addition of training to follow the trails both of the master and any designated person whose scent can be adequately given, and of identifying any one person among a group of others by scent. This last feat, while inadmissible as evidence under the law, has frequently had a powerful psychological effect on the criminal and resulted in a free confession. It is a curious fact that a person under the strain of a strong emotion such as fear or a guilty conscience, gives off a much stronger personal odor than any one else, and the task of the dog is therefore very much easier when on a real job, than when at a field trial.

It would be unnecessary to enumerate the variety of duties assigned to thousands of properly trained dogs in Europe. Suffice it to say that the railroads use them to protect their freight and express depots, postoffices use them to protect their registered mail, factories and shops use them to supplement their watchmen and guards, cities such as Amsterdam and Bremen assign them to their blinded veterans and civil wards as guards. Revenue officials use them against smugglers, forest and game wardens use them against poachers or trespassers. These are only a few of the activities successfully required of them and every year opens up new and unsuspected ways of working this essentially useful animal. The shepherd dog can and should be a national asset provided he is bred and raised as he is intended to be, as a domestic animal whose true standard of beauty is that of efficiency in the service of mankind.

A New Study of Twins

DIE ZWILLINGSPATHOLOGIE, ihre Bedeutung, ihre Methodik, ihre bisherigen Ergebnisse, by Dr. Hermann Werner Siemens, privatdozent of Dermatology at the University of Munich. Pp. 103, with 14 illus., Price 90c. Berlin, Verlag von Julius Springer, 1924.

Twins have long been a favorite, though by no means an exhausted, subject for students of heredity; but most of the students—Galton, Thorndike, Wilder, and so on—have devoted themselves to the normal traits. Dr. Siemens limits himself to abnormalities and the manifestations of disease. He has had an opportunity in Munich to collect a great deal of material, and his classified list of the abnormalities found in twins, with details as to their distribution and apparent inheritance, will be useful to all geneticists. The discussion of the general bearings of this information is extremely interesting, although the author is handicapped by not having seen some of the recent studies that have been published in English, such as those of C. B. Davenport and R. A. Fisher. Dr. Siemens thinks the study of twin pathology will throw light on a number of problems of heredity that have hitherto been obscure. It will (1) show that some traits, universally supposed to be heritable, are not such; for instance, left-handedness, which he found in ten pairs of identical twins, but in only one pair were both twins left-handed. Birthmarks the author places in the same category. (2) It will show that the inheritance of some germinal traits is not as simple as has been thought, but complicated. The example given is freckles, which some German writers have listed as a simple dominant. (3) It will reveal a disposition to certain abnormalities that are not themselves inherited: goitre is the example given. (4) It will illuminate the whole problem of identity of inheritance in twins themselves.

P. P.

KARAKUL RAM RELEASED IN THE ROCKY MOUNTAINS

FIGURE 18. The ram was released not far from Ouray, Colorado, in January, 1923, near a place where Rocky Mountain Sheep were known to feed. He was not seen again until the latter part of March, when he was accompanied by three ewes. It seems likely that crosses between Karakuls and the Rocky Mountain Sheep would be very hardy, and it is hoped that their skins would be valuable, for the mountain sheep have very coarse, brittle wool.

HARDINESS OF KARAKUL SHEEP

Further Evidence that These Sheep Are Able to Withstand Adverse Conditions

C. C. YOUNG
Denver, Colorado

IN a recent number of the JOURNAL OF HEREDITY* the author called attention to the ability of the Karakul sheep to subsist under desert conditions that would be fatal to other breeds of sheep. Another test of the hardiness of these sheep under entirely different and even more trying conditions was made during the winter of 1922-23.

In January, 1923, I delivered a Karakul buck to the Sportsmen's Club of Ouray, Colorado, for the purpose of having him turned out among a flock of Rocky Mountain sheep that frequent certain parts of the valley near that town in severe winters when the feed becomes scarce in the mountains. These sheep, owing to the mild winter, did not come down to their usual feeding place and the ram had to be released in the mountains where wild sheep were seen several days before. In April, 1923, I was informed that the government ranger had seen the buck in company with four ewes. In July he was reported to be back in the hills and quite high up—living in solitary splendor.

One of the objects of this test was to establish whether or not the ram would come back next winter with the wild sheep, which would be a striking proof of the hardiness of the Karakul sheep. The main reason, however, was to ascertain whether the Karakuls will mate with the Rocky Mountain sheep, which possess a stiff, coarse and brittle hair. It is not unreasonable to believe that lambs from this cross would have skins with the tightest kind of curls, so much in demand with furriers.

*Journal of Heredity 13:229-236. 1922.

UNIFIED COTTON COMMUNITIES

Study of Heredity Leads to Reorganization of an Industry.

O. F. Cook,

Department of Agriculture, Washington, D. C.

A NEW form of social organization is being developed in the cotton industry, for more effective application of science in the field of production. Through a very simple form of cooperation, for growing only one kind of cotton in each community, the way is opened to general improvement of seed supplies and other essential factors of production. The primary object is to utilize superior varieties of cotton, but community agreement sesures many other advantages that are not in range of individual effort. The need of one-variety communities became apparent through investigations in cotton breeding and the practical advantages have been confirmed by experience in establishing a new branch of the cotton industry in the Salt River Valley of Arizona, where the Pima variety of Egyptian cotton has heretofore been grown exclusively, and pure, uniform seed stocks have been maintained.

The usual practice of planting ordinary "gin run" seed is responsible for a rapid mongrelizing of varieties, so that cotton of irregular, inferior quality is produced, and this inferiority of the fiber leads in turn to enormous wastes of labor and of other industrial and economic resources. Farmers generally are losing from 2 to 10 cents a pound by growing needlessly inferior cotton, and the production costs are higher on account of low yields. In the degenerating mixed stocks many plants are unproductive, and some are quite sterile.

Disadvantages of Inferior Fibre

Manufacturing is more expensive with low-quality cotton, which is harder to work in the mills. Threads drawn from weak, irregular fiber break more frequently in spinning and weaving, and the fabrics soon wear out, so that more goods and garments must be made. The consuming public pays hundreds of millions of dollars every year for the unnecessary labor and the more frequent renewal charges of inferior cotton products, and the burdens of our existence are increased in many other ways, some scarcely suspected. Weak, perishable cotton disintegrates rapidly in clothing and bedding, and adds to the dust that we breathe day and night in our houses. Thus questions of public health are involved, as well as that of operatives in cotton mills, in the general use of inferior fiber. Living conditions may be improved, as well as money saved, by using stronger and more durable cotton for clothing, bedding and other domestic purposes. Not only the cheap shirts or tires, but most of the high-priced articles lack durability because they are made of cotton that is not uniform in length or strength of fiber. Finer spinning of inferior material is the line of progress that has been followed in the manufacturing industries, through improvement of textile machinery, while improvement of the varieties of cotton and of the essential quality and uniformity of the fiber has been neglected.

In order to avoid mixing, crossing and "running-out" of varieties, it is necessary that communities be organized, at least to the extent of agreeing to plant only one variety in each neighborhood, by all of the farmers who take their cotton to the same gin. With different varieties grown on adjacent farms, the seed mixed at the gins and the plants cross-pollinated in the fields,

it is out of the question to maintain the purity and uniformity of any variety on a scale of commercial production. The general and inevitable result, under the present system, is that varieties are not kept pure after the stage of commercial production is reached, but are mongrelized and discarded after a few seasons. A history of the commercial cotton industry would show in each region a rapid succession of varieties, most of them grown only a few years and at no time adequately utilized, since no large stocks of really pure, uniform seed are developed or maintained under the usual conditions of production. Thus the present inferiority of cotton fiber traces back to the lack of pure seed and to the unorganized condition of production, which interferes with keeping seed pure. Breeding superior varieties is of little effect in improving production unless it is possible to have large stocks of pure seed, for the millions of acres of cotton that are planted every year. The practice of selection and isolation of seed stocks must be greatly extended in order to produce high-quality fiber by the thousands and millions of bales.

Adequate supplies of good seed of the Pima variety are made available in the Salt River Valley of Arizona, and of the Acala variety in the Coachella Valley of California. Organized efforts are being made in many other communities, which need to be recognized and assisted in the interest of agricultural and social progress. In the same way that sociologists trace the general progress of civilization through the development of "institutions" or forms of organization, so the progress of a particular industry may depend upon a needful cooperative relation being established. The present condition of unorganized production, that interferes with the use of superior varieties, must be reckoned as a serious limitation of the progress of the cotton industry, but one-variety communities can advance to a higher plane and maintain uniform qualities of fiber by keeping their seed pure. To devise and develop institutions that are required in the interest of progress is practical sociology and practical agriculture as well, in the cotton industry.*

That the study of heredity and the breeding of superior varieties should lead to a recognition of the need of a different organization of the industry may appear as an unusual application of biology to agriculture, but the facts should not be disregarded because the advantages of one-variety communities have been recognized only in recent years. Larger crops and better cotton can be raised, and many other features, ginning, handling, marketing and manufacturing, can be improved, simplified and economized in organized community production. Not only the seed-breeding and the cultural problems, but also the industrial, economic and social problems of the cotton industry need to be studied in their new aspects, in one-variety communities. No doubt the same principles apply in other branches of agriculture, though all do not have the same industrial requirement of a uniform product, or of unified community action to maintain supplies of pure seed.

*See "Cotton Improvement on a Community Basis," *Yearbook, U. S. Depart. of Agric.* for 1911; pp. 397-410; "Cotton a Community Crop," *Journal of Heredity*, 11:174; 1920; and "One-Variety Cotton Communities," *U. S. Dept. of Agric. Bull.* 1111, November 25, 1922.

Index to Volume XIV

Is now ready and will be sent to members on application.

THE CHINESE BUSH CHERRY

Prunus tomentosa—a Promising New Fruit Adapted to Arid Regions and Hardier than the European Cherry.

GEORGE M. DARROW
U. S. Department of Agriculture, Washington, D. C.

ORCHARD OF BUSH CHERRIES NEAR PEKING

FIGURE 19. It is situated in the Ming Tombs Valley, northwest of the Chinese capital. The bush cherry endures lower temperatures and more arid conditions than the European cherry, and is proving well adapted to parts of the United States where the latter species does not thrive. Photograph by Frank N. Meyer, January 5, 1906.

THE bush cherry, *Prunus tomentosa*, has been known and valued by landscape gardeners and ornamental nurserymen of America and Europe less than half a century, though its beauty has long been prized in the Orient. Its possible value as a fruit, however, had been overlooked until recent tests in North Dakota and Canada demonstrated that it has certain superior qualities. Not only does the bush endure lower temperatures, but it is adapted to more arid conditions, and has proved to be hardier than the cultivated sweet and sour cherries of America. Its foliage is resistent to the common leaf diseases of other cherries. The fruit, eaten out of hand, has the taste of a true cherry and all seedlings tested by the writer have yielded a beautiful red jelly of delicious flavor. The unripe fruit is also pickled in salt or boiled in honey and served as a delicacy. The fruit, foliage and bush characteristics, together with its beauty as an ornamental, combine to make this cherry from China a promising new fruit.

Prunus Tomentosa in Its Native Home

Prunus tomentosa is a native of Asia, ranging from southern Manchuria through northern and western China, Tibet, and into the Kashmir region of Northern India. In latitude

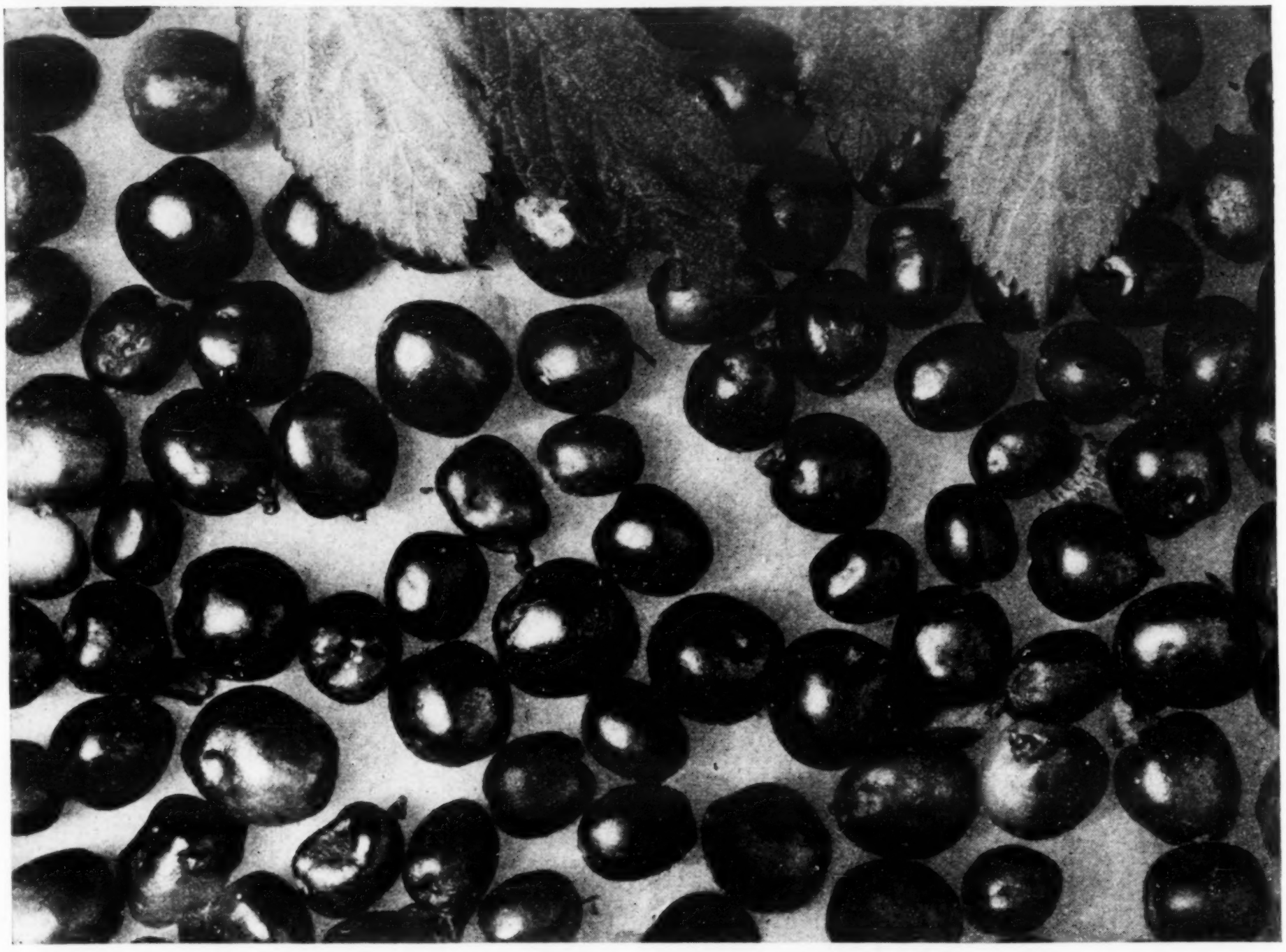
CHINESE BUSH CHERRY IN CENTRAL NEW YORK

FIGURE 20. This small bush of *Prunus tomentosa* is growing in Durant Eastman Park, Rochester, New York, and was photographed in November, 1920. Some of the other seedlings growing there were entirely defoliated at that time.

and climate this covers ranges of territory and conditions comparable to those from the mountains of eastern New Mexico northward to North Dakota, which regions, for the most part, are semi-arid.

It first attracted attention in Japan where it is not native but is frequently grown as an ornamental. There it was collected by Thunberg, described by him in 1784, and named *tomentosa* because of its hairy leaves and slightly hairy fruit. By the Japanese it is called "Yusuraume."

In the rougher portions of Manchuria it occurs only on the hillsides where the bushes are usually three to four feet high and, in early summer, are red from the abundance of fruit. In the plains regions of Manchuria it grows in the drifting sand dunes. So far as is known, it is not raised there except as a dooryard ornamental. Children are said to be fond of this



FRUITS OF THE CHINESE BUSH CHERRY

FIGURE 21. Considerable variation in size and shape is evident. The fruit is much smaller than that of the common cherry, and averages just over half an inch in diameter. From seed of this fruit some of the selections recently made were grown. Photograph by Frank N. Meyer, June 1, 1914.

fruit, and baskets and branches laden with the brilliant red cherries are sometimes sold in the markets. Fine preserves are said to be made from it there.

In China it has been collected in many parts of the northern and western provinces and, according to Bretschneider, it is "a shrub much cultivated at Peking for its cherry-like edible fruit." It is called "mountain cherry" by the Chinese. Bretschneider sent seed to the Arnold Arboretum, Boston, Massachusetts, in 1882, from which plants were grown. This institution sent part of the seed to the Rochester parks at that time (1882) and since then has distributed seed produced by their plants to other institutions. Bushes set out at the Central Experiment Farms, Ottawa, Canada, in 1900 were grown from seed furnished by the Arnold Arboretum. F. N. Meyer collected it many times in Manchuria, in various provinces of China and in Chinese Turkestan. Most of the plantings from which selections have been made in America were obtained by Meyer in June, 1914, in or near Peking and may have been from plants cultivated for their fruit. Figure 19 shows a plantation of this cherry northwest of Peking. Recently, large quantities of seed which may be of similar stock have been imported by nurseries and others through Nanking University, Nanking, China.

Sargeant lists and describes ten botanical varieties in *Plantae Wilsoni,* basing his classification on the color, size, and other characteristics of the flower and the hairiness of the fruit.

Ornamental Value

At the time Bretschneider sent seed to the United States (1882), plants were listed and were being sold by at least one nursery, Ellwanger & Barry, as a desirable ornamental. Since that time it has been propagated and it is now handled by several nurseries.

"The mountain cherry" is one of the earliest of all shrubs to blossom in the spring, coming into flower in March in the vicinity of Washington and early in April in Massachusetts. However, *Prunus mume*, the Japanese flowering apricot, *P. armeniaca*, the common apricot, *amygdalus davidiana*, the Chinese wild peach, and *P. concinna*, a small wild cherry of Central China, blossom earlier. *P. tomentosa* blooms very profusely, the branches being covered with flowers which open from pink buds just as the leaves start. Their bright red stalk and calyx make a handsome contrast with the white petals which are often blotched with rose. Later the brilliant red, sometimes white, fruit contrasts well with the rich green foliage.

The bush rarely grows more than five to six feet high, although some old plants eight to nine feet in height occur. An old bush in Highland Park, Rochester, New York, raised from seed sent by Bretschneider from China, is at least twenty-five feet across and eight feet high. Its dense rich green foliage is resistent to the diseases that attack and defoliate the common sweet and sour cherries, and persists until after the first autumn frosts.

Value as a Fruit

Though Bailey, in the *Standard Cyclopedia of Horticulture*, and Hedrick, in *The Cherries of New York*, mention its possibilities as a plant for domestication, P. H. Dorsett and the late Frank N. Meyer of the Office of Foreign Seed and Plant Introduction seem first really to have appreciated tomentosa's true value. Mr. Meyer collected it a number of times; he sent plants from China as early as 1905, and in 1914 sent in 116 pounds of seed of a "fruiting shrub of great promise." Mr. Dorsett with Mr. Meyer visited the Central Experiment Farms at Ottawa, Canada, in 1912, where about seventy-five bushes were growing and became enthusiastic about its possibilities.

Since then reports have been received from many places; from Augusta, Georgia to Salem, Massachusetts, and westward to Mandan, North Dakota, indicating that this cherry succeeds and fruits under a wide range of conditions.

A collection of seedlings growing at Rochester, New York, has been observed for the past two years. In 1922, some of the bushes ripened their fruit by June 25, others not until the middle of July, while some fruit on the bushes in the middle of August was still in good condition. Some of the young bushes bore several quarts of fruit, others much less, varying in size, shape, color, texture of flesh and in flavor. All those tested made a red jelly of the finest color, each having its own characteristic flavor. The bushes also varied greatly, some having a dense, others an open growth.

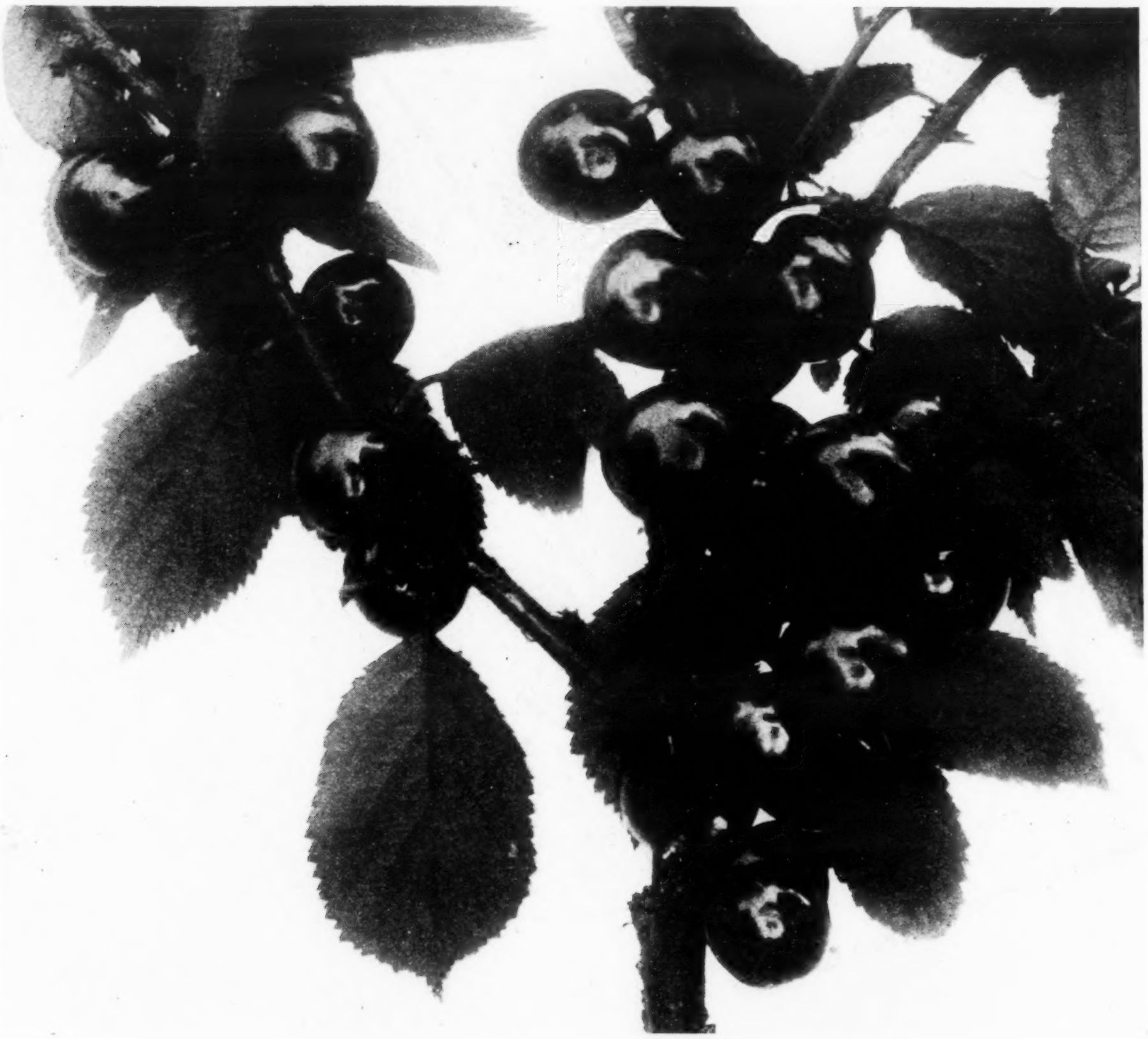
Reports from other sections of the United States indicate that *P. tomentosa* is decidedly variable. A letter from Mr. Wm. Pfaender of New Ulm, Minnesota, states that from about thirty seedlings which he secured in 1916 from the Office of Foreign Seed and Plant Introduction one bore fruit fully as large as that of the Early Richmond. This particular seedling, however, has not proved productive with him.

Selection and Breeding

The first step in the improvement of this fruit is naturally that of selecting hardy, productive, large-fruited seedlings of varying flavor and seasons. Not all seedlings have proved to be entirely hardy in the region from Iowa to North Dakota. The

BRANCHES LADEN WITH FRUIT

FIGURE 22. These are from two bushes of *Prunus tomentosa* growing at Chico, California.



FRUITING BRANCH OF THE BUSH CHERRY

FIGURE 23. The short stems by which the fruit is attached usually remain on the branch when the cherries are picked. Fruit from all seedlings tested makes a fine red jelly, that from each plant having a characteristic flavor of its own.

great majority are unproductive, though a few fruit freely. The fruit is much smaller than the common cultivated cherries, averaging just over one-half inch in diameter. Seedlings of the best selections should be raised for further selection, and introductions of seed from various semi-arid and humid parts of Asia, from which to raise seedlings, should be made. In addition, propagations of the best fruited sorts under cultivation in China and Manchuria should be secured.

The Arnold Arboretum reports a natural hybrid between *P. triloba,* a small almond from Northern China, and *P. tomentosa* which appeared in the Arboretum among seedlings of the former. Although a vigorous shrub, it is said to be unproductive.

Mr. Harlow Rockhill, the strawberry breeder at Conrad, Iowa, has nine first generation hybrids with the sand cherry, *P. besseyi,* which fruited in 1922. They bloomed a week or ten days later and were more cold-resistant than *P. tomentosa.* The fruits were all dark colored with dark juice and intermediate in size between the parents. He also has one plant of a cross of Montmorency × *P.*

PRUNUS TOMENTOSA IN FLOWER

FIGURE 24. This bush flowered only a year after being planted at Holly Hill, South Carolina. Favorable reports of the new cherry have been received from places as widely separated as Augusta, Georgia, and Mandan, North Dakota.

tomentosa five or six years old which has not fruited, two small plants of *P. tomentosa* × Napoleon, seedlings of Zumbra × *P. tomentosa* and second generation seedlings of the sand cherry × *P. tomentosa*. It is, therefore, possible to make successful crosses with other forms of Prunus and the fine foliage, bush form, hardiness, early bearing, and wide adaptability of this species indicate the desirability of so doing.

Propagation

F. N. Meyer, in 1907, wrote from Peking, that *P. tomentosa* " can be propagated by budding on *Amygdalus davidiana* and by division, layering and sowing." Later, in 1910, he wrote: "Stands drought and alkali quite well.——— In Chinese Turkestan this fruit is propagated by division but in North China it is budded on *Amygdalus davidiana* as it grows then much faster in the latter case and stands drought and transplanting much better than on its own roots."

Amygdalus davidiana has been extensively used by the Department of Agriculture as a stock for this cherry and it has been found satisfactory. *Prunus nigra* has been used by the Northwest Nursery Company, Valley City, North Dakota, on which to bud a selection made by them and is considered satisfactory as a stock.

The writer has plants on *Amygdalus davidiana* which have made a splendid growth. He also has vigorous seedlings on their own roots. In 1923, plants were propagated from hardwood cuttings, using the same methods employed in propagating currants, and by autumn bushes three feet high had developed. Bushes were also moundlayered as are gooseberries, and roots appeared on the branches by fall, though perhaps not as many as with the gooseberries. The Department of Agriculture also has one vigorous plant budded on *P. besseyi*, the sand cherry. Because of the abundance of wood produced, propagation by hardwood cuttings is likely to be the most desirable method if all selections grow freely from such cuttings. For special conditions, however, *Amygdalus davidiana* and *P. nigra* may prove best as stocks.

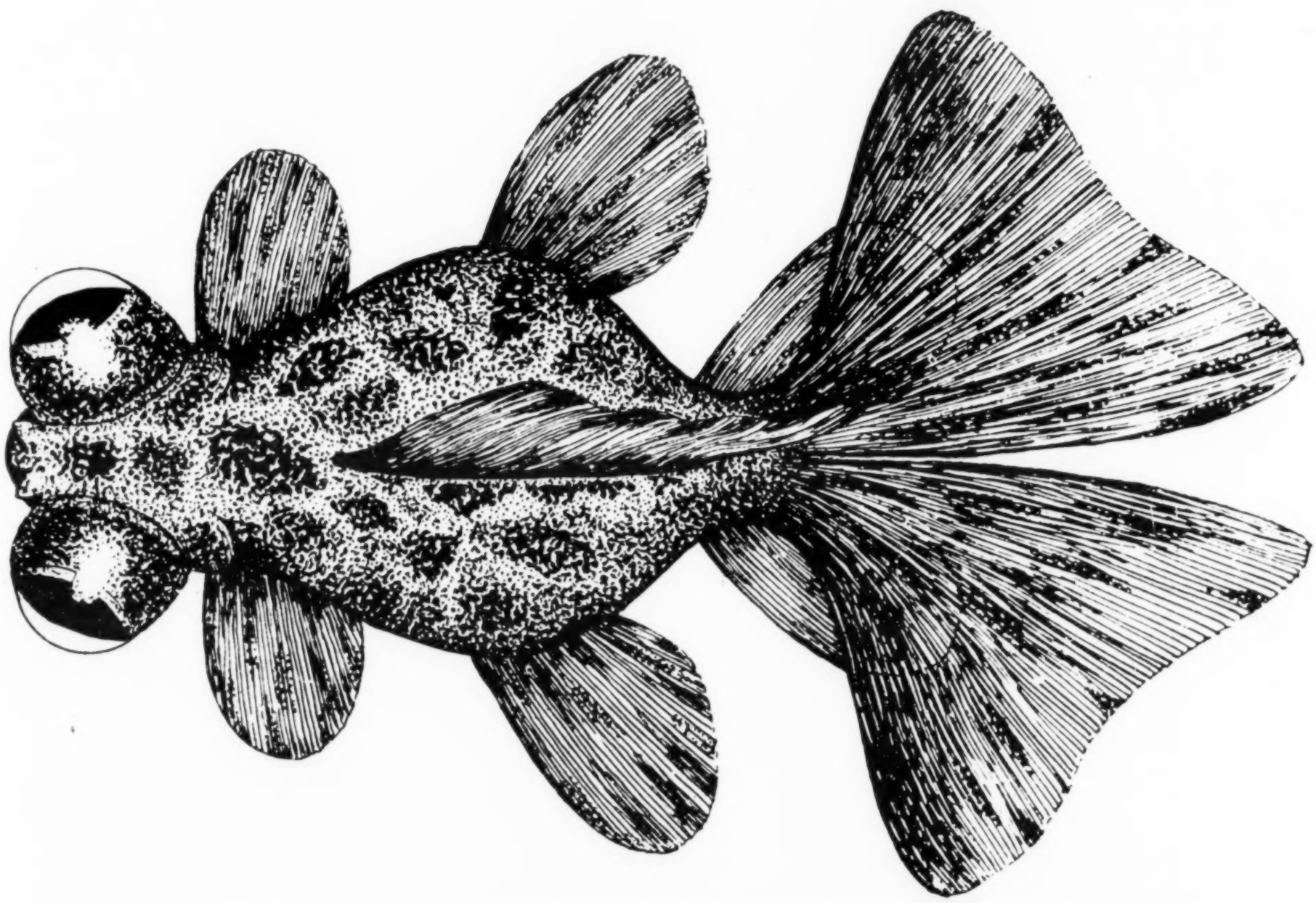
Growing from Seed

In growing *Prunus* from seed it has been the writer's custom to wrap the seed in fine wire gauze and bury it about a foot deep until early spring when the seed was sowed in the field or in flats. Seed of *P. tomentosa* was handled in this way in 1922 and when the packages were dug in February, 1923, from the frozen soil, the seed had all germinated, many having radicals two to three inches long. All were lost. In the fall of 1923 seed was handled in a similar manner but the packages were dug early in December. At that time many of the seed had germinated—a few even having radicals an inch long, but by careful handling and sowing in flats nearly all were saved. It is evident, however, that the seed should not be stratified, but should be kept dry until late fall when it is then sown in the field or in flats as the case may be.

HEREDITY IN GOLDFISH

A Note on the Inheritance of Dove-Tails and Telescope-Eyes in Goldfish.*

ROBERT T. HANCE
University of Pennsylvania.

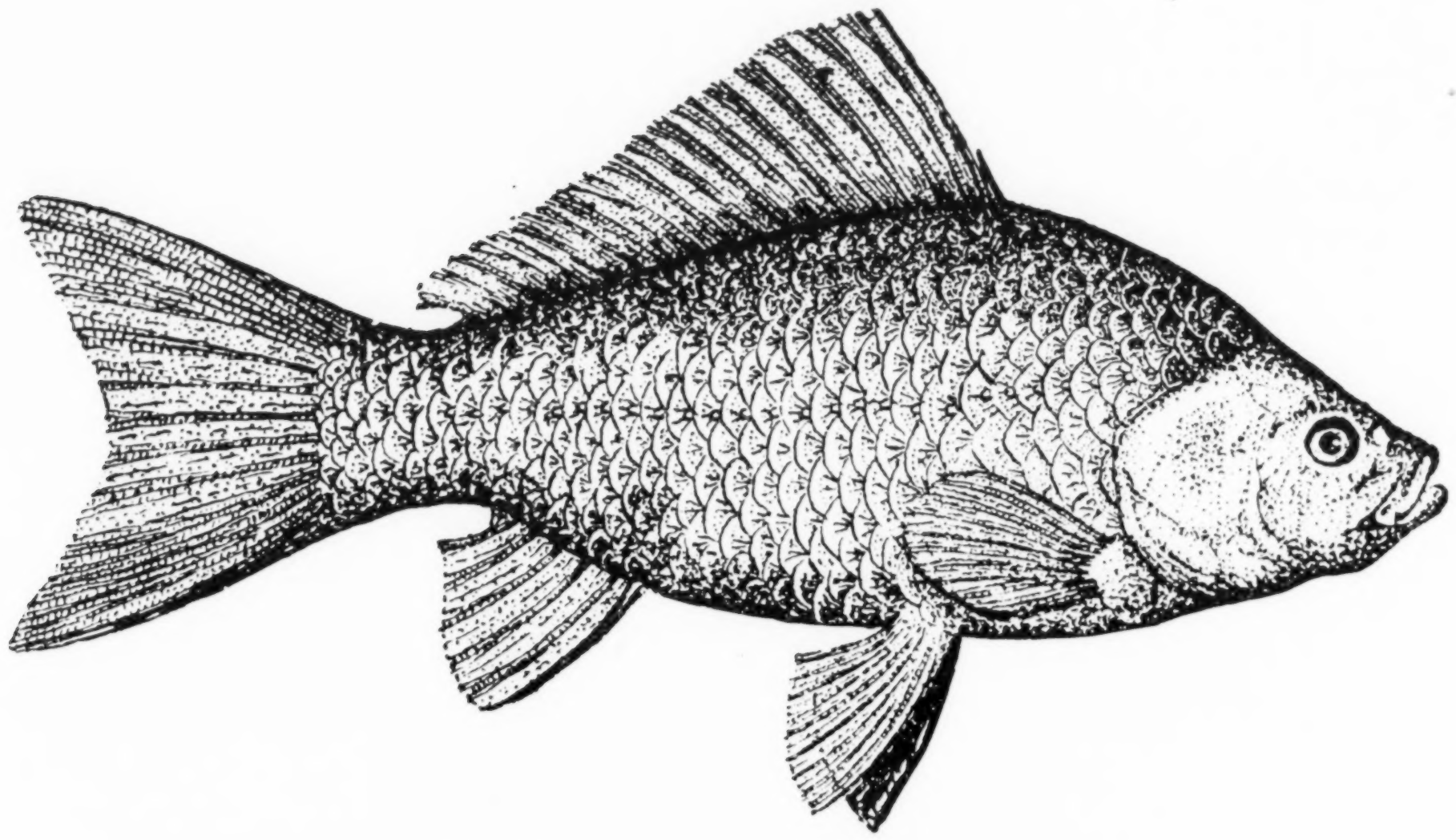


CHINESE MOTTLED TELESCOPE-EYED GOLDFISH

FIGURE 25. A dorsal view of one of the strange varients of the golden carp developed by the Chinese. A number of theories have been advanced to account for the origin of these unusual forms, but it seems most probable that they have arisen as mutations from time to time, and artificial selection has done the rest.

DURING the breeding season goldfish spawn at intervals of two weeks or longer and experienced breeders claim that large vigorous females may breed as frequently as eight times during the spring, although four or five matings appear to be more usual. The number of eggs spawned range from a few hundred to several thousand at one period depending on the size of the female, and consequently the season's production, even allowing for unfertilized ova, is quite large. Goldfish spawn for periods varying from two to eight hours, with the result that several lots of eggs from one female may be fertilized by different males. Such qualifications are obviously of great value in material used for studies on inheritance. Because of the excellent facilities afforded at this Laboratory for aquarium studies

*The illustrations have been taken from *Goldfish Breeds*, by H. T. Wolf through the courtesy of the publisher, Innes and Sons, Philadelphia.



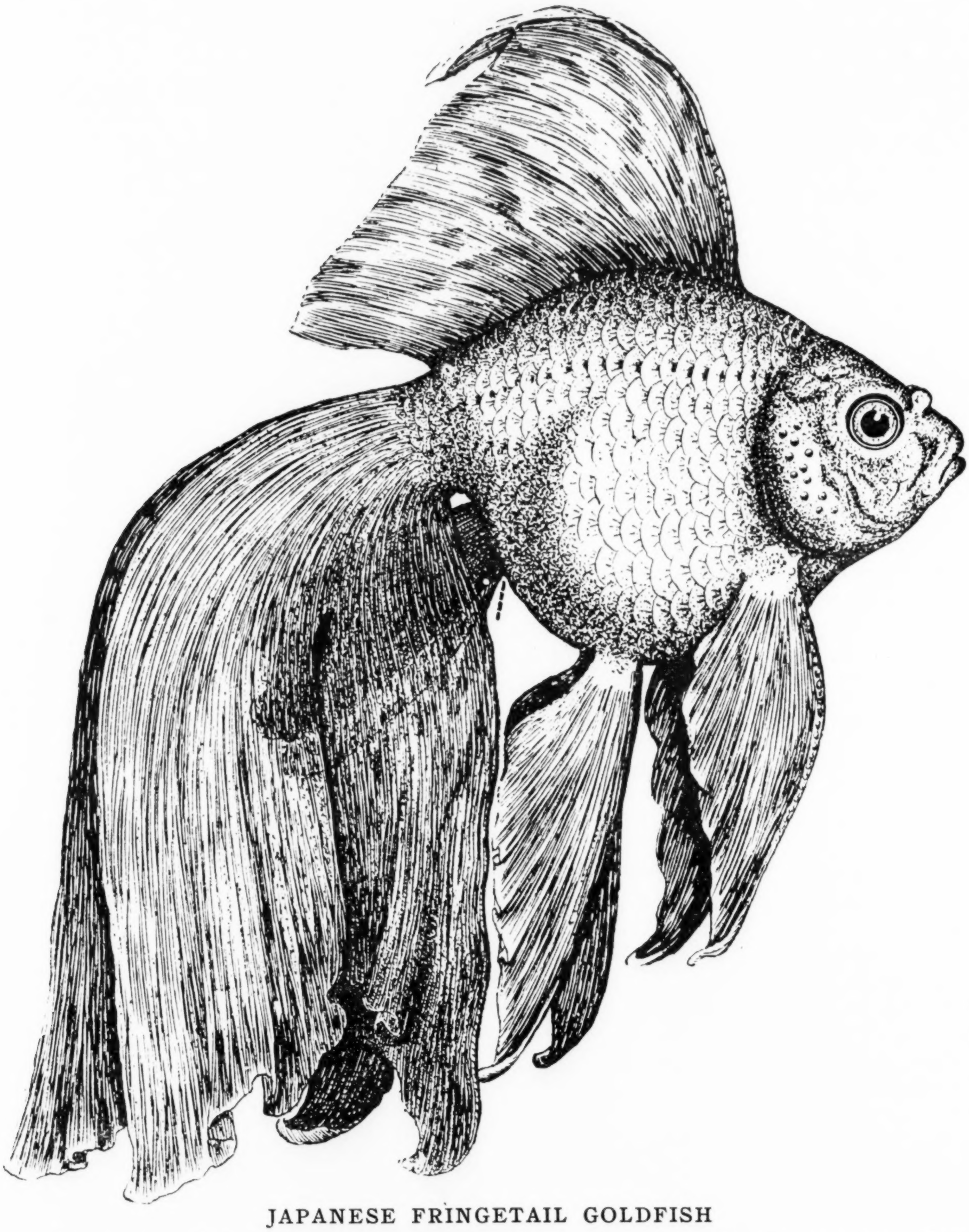
COMMON AMERICAN GOLDFISH

FIGURE 26. The goldfish is derived from the golden carp, and is thought to have originated in a lake near the mountain Tsienking in the province of Tohe-kiang, China. It was distributed throughout China and Japan in early times and was brought to Europe in 1611.

on a large scale, an investigation on the genetics of goldfish, which seemed to be such favorable material, was begun several years ago. As this investigation has been temporarily discontinued it is believed that a note on the general problem and on such results as have been obtained might be of interest.

Unfortunately it has become evident that fish, even as chickens, should not be counted before they are hatched or, more exactly in this case, at too long an interval after hatching. The fertilized eggs hatch in due time and only a small percentage of the fry die—a natural death. The smaller fish, however, soon fall victims to their brothers' appetites, to the very evident benefit of the latter, but to the detriment of a study in genetics. It would be possible to eliminate most of the losses from this source by removing the larger fish from day to day. Regardless of the high mortality (breeders, I am told, consider themselves successful if they are able to raise five per cent of the eggs spawned) there is much valuable work that may be done in the study of the relation of colors and of the various types of fins and eyes, work that would not only be of theoretical value but also of considerable economic importance. Fish possessing what are considered fancy points sell readily for from ten to fifteen dollars and even more for exceptional individuals. Obtaining the desired characters is, at present, largely a matter of chance.

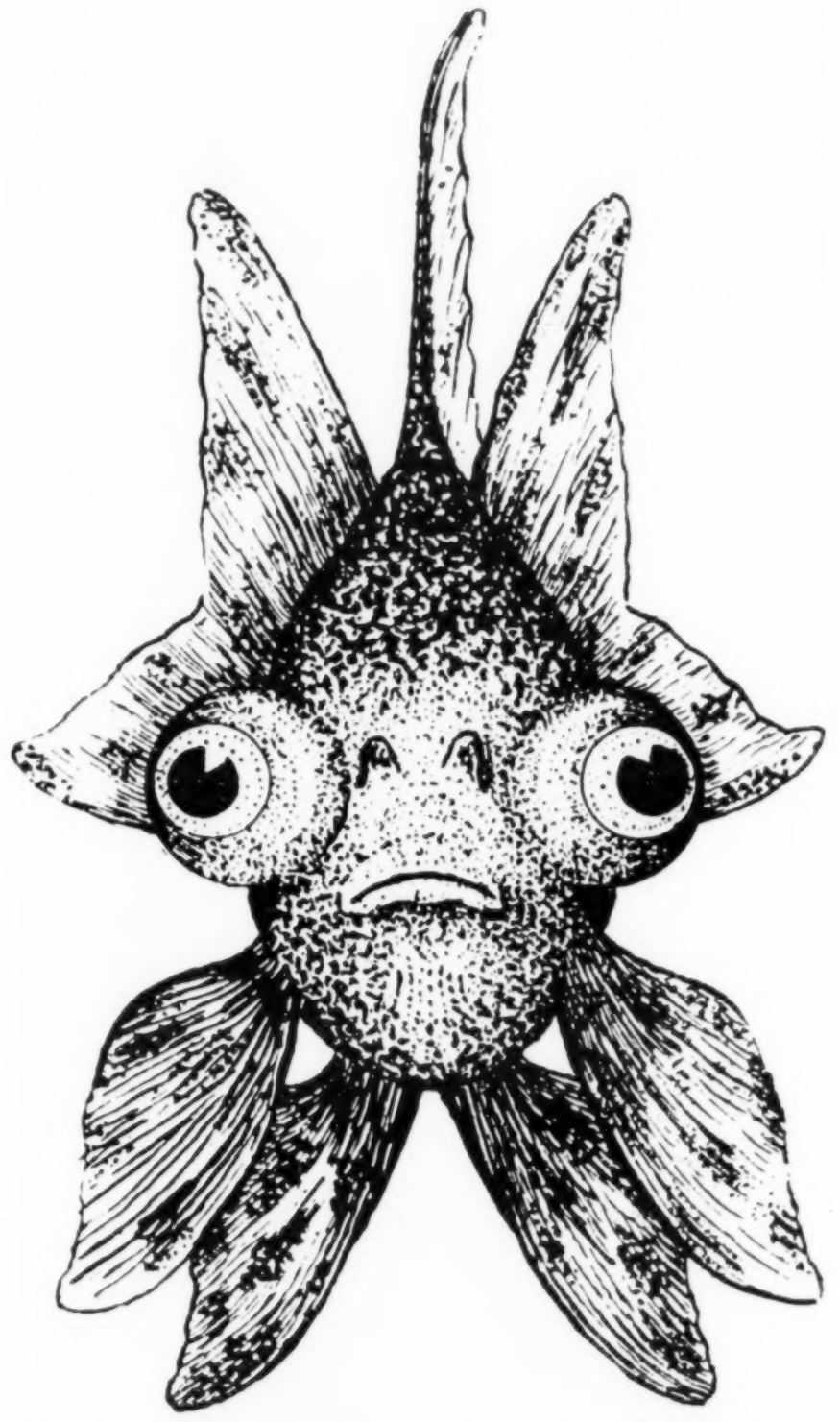
As yet I have no definite ratios to present, due to the above stated reasons, and this makes the work of little immediate value from a genetic standpoint. There are a few characteristics, however, that stand out rather clearly and that justify this report, if for no other reason than to attract attention to the availabiliy of goldfish for laboratory work and to outline the problems involved. Goldfish are readily obtained in almost every locality and are thoroughly normal in environments in which few wild fish could exist. As they breed in tanks containing not more than fifteen or twenty gallons of water, they form excellent material for the study of the breeding habits of fishes



JAPANESE FRINGETAIL GOLDFISH

FIGURE 27. This is considered the most beautiful of the different varieties. Some biologists have maintained that the Orientals produce such abnormal forms by shaking the eggs at a vital stage of development, and that these variations are then perpetuated. In the light of modern knowledge this view is hardly satisfactory.

in elementary classes or in animal behavior work. Cypress boxes a foot or more square and three feet long make excellent breeding tanks. The feeding and cleaning habits of the fish may be watched through glass sided tanks. For inland laboratories the eggs of the goldfish are the most convenient and abundant live material available for the study of embryology. It is not practical to strip these fish because the eggs are so sticky that they clump together and adhere to the fingers of the operator or to anything else that they touch. Moreover, I have never been able to obtain sufficient milt from the male by stripping. However, the eggs may be accurately timed as they are spawned against the plants in the aquarium, the whole process being entirely visible. They adhere to the plants and may be removed on them. The eggs take from two days to a week or more to hatch, depending on the temperature. If the fish have been properly fed in the fall, they may begin to spawn as early as January or February if they are kept in a fairly warm place. Directions for breeding may be found in the books of Smith[3]* and of Wolf.[4]



FRONTAL VIEW OF TELESCOPE-EYED GOLDFISH

FIGURE 28. This is another view of the variety shown in Figure 25. Such forms doubtless appear from time to time in the wild, but are almost immediately exterminated on account of their extreme helplessness.

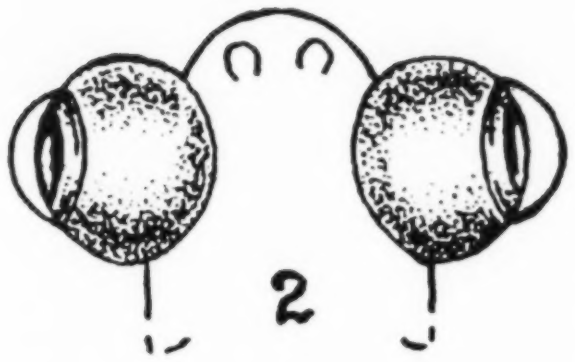
Color Inheritance

The relations of the various colors found among goldfish have never been explained. That the problem is an intricate one is evident from the results obtained from breeders. One of the most striking examples is the case of the black "goldfish" which may after a time turn a beautiful ox-blood red. Whether there is a congenital difference between a fish that maintains its original color and one that originally had a similar color which finally changes, it is not possible to say at present. Such processes go on in the same aquarium, so they are apparently at least, not due to environmental influences. Breeders in the central states have told me that fish raised in out-of-door pools in which there is a large amount of limestone are always brassy in color (a shade that is of little value in the market) and several weeks before being sold they are transferred to pools with a loam soil bottom which produces the much prized rich red color. Here is an apparent effect of the environment.

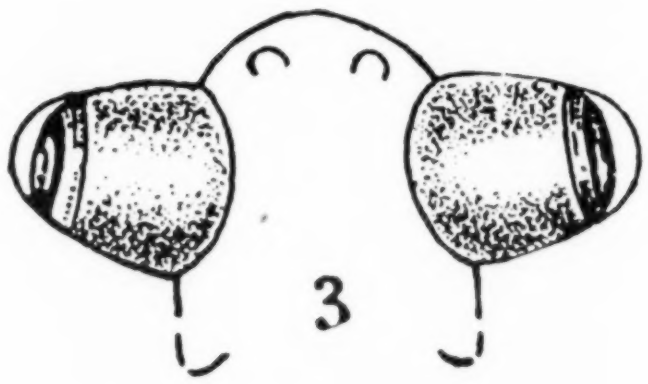
As far as I have determined, white in goldfish is recessive to red and black. The double tail and double anal fin are recessive to the normal single conditions. That the single tailed fish may be heterozygous for the double or fan tail is evidenced by the offspring of single tailed fish, some of which pos-

*For numbered references see "Literature Cited" at end of the article.

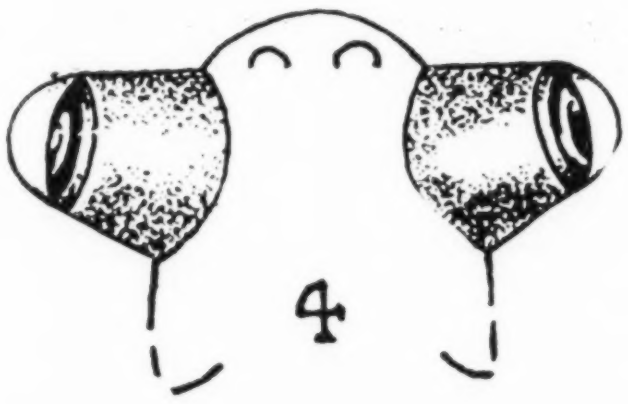
1. **Common Goldfish, Fringetail, etc. — flat eyes.**



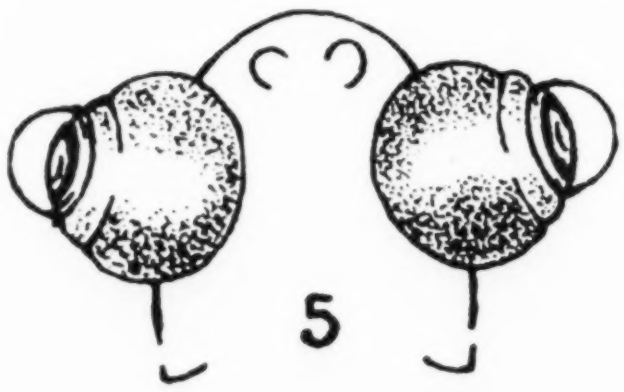
2. Chinese Telescope Goldfishes—as spheres.



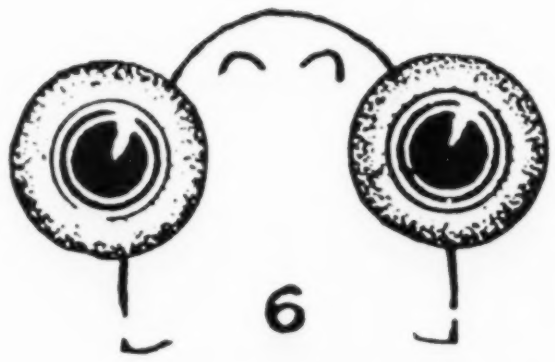
3. Chinese Telescope Goldfishes—as ovoids.



4. Chinese Telescope Goldfishes — as truncated cones.



5. Chinese Telescope Goldfishes—as segmented spheres.



6. Chinese Celestial Telescope Goldfishes as spheres, with pupils turned upwards.

TYPES OF EYES FOUND IN GOLDFISH

FIGURE 29. There is little evidence available as to how or in what order these abnormalities have originated.

sessed fan tails. Also the protruding or telescope eyes seem to be recessive to the normal eyes, although my evidence for this is slight at present.

Ryder's theory[2] of the origin of the fan tails is hardly satisfactory in light of modern knowledge. It was his belief that the double tails were produced by the Orientals' shaking or interfering with the eggs in some way at a vital period of development. This treatment with other fish produces abnormalities and Ryder believed that a similar explanation might fit the gold monsters and that selection would account for the rest. The experimental abnormalities have never been shown to be hereditary and it is very difficult, indeed, to understand how such treatment would influence the germ cells in a manner to perpetuate the same defect.

In contrast to this statement are the claims of Tornier (reviewed by MacBride[1]) who has attempted an experimental analysis of the inherited abnormalities found in goldfish. He has come to the conclusion that improper environment (lack of oxygen and food) tends to upset the normal physiological balance, resulting in the strange forms and colors we have today. Some of my own observations, though by no means conclusive as yet, do not agree with Tornier's conclusions and in any case the latter's data falls short of demonstrating that very desirable possibility—the inheritance of acquired characters. His work seems clearly to show how abnormalities may be produced artificially, but by no means indicates how they may become fixed and passed on as such to the next generation. It is easier to comprehend how a germinal change or mutation can affect the body coming from it than to imagine the reverse, and the fact that in the former case we are under the necessity of explaining the cause of the mutation or change does not make the latter any more probable. Many people seem to think that the majority of biologists are unalterably prejudiced against the possibility of the inheritance of acquired characters when they simply refuse to accept the inadequate proof offered by the acquired character advocates. As a matter of fact, there are few things that would be hailed with greater enthusiasm than a clear-cut demonstration of a specific acquisition being passed on intact.

While I may be accused of substituting words for an explanation, it seems more likely that among the millions of fish raised in the Orient germinal mutants must have appeared with double tails, telescope eyes, short bodies, and other abnormalities, and then artificial selection entered and played its role. It also seems probable that the double-tailed fish may appear in the wild and are almost immediately exterminated because of their extreme helplessness. In my aquaria at the beginning of the summer were a number of small fan-tailed fish together with single-tailed brothers. At the end of the summer the brothers were still present but there was only one double-tailed fish remaining.

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[1]MacBride, E. W. The Work of Tornier as Affording a Possible Explanation of the Causes of Mutation. *Eugenics Review,* Vol. 15, No. 4, 1924.

[2]Ryder, John A. The Inheritance of Modifications Due to Disturbances of the Early Stages of Development, Especially in the Japanese Domesticated Races of Gold-carp. *Proc. Acad. Nat. Sc. Phila.,* pp. 75-94. 1893.

[3]Smith, Hugh M. *Japanese Goldfish.* W. F. Roberts Co., Washington, D. C. 1909.

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BIOLOGICAL LIMITS IN THE DEVELOPMENT OF SOCIETY

STUART A. RICE
Dartmouth College

NO SUBJECT of sociological inquiry within recent years has proved to be more controversial than the effort to determine the relative importance of biological and of purely social factors in the development of human society. On the one hand we have a "biological" school, composed in great part of earnest experimentalists, whose views have been popularized by Stoddard, Grant, Goddard, and others. This group believes that differences in social status, whether racial, national or individual, represent fundamental inherited differences in biological structure and capacity. On the other hand we have a group referred to as the "cultural" or "anthropological" school, which regards racial and national differences, and to a large extent individual differences as well, as significant of acquired and socially perpetuated characters.

It may be useful to regard the opposing views as based in a disagreement over the location of what may figuratively be described as the *biological limits upon society*. It is the purpose of this paper to illustrate the concept, analogical though it be, by reference to some problems of social structure and organization.

For convenience we may think of human society as having lower and upper biological limits. Below the lower limits, society as we know it could not exist. Beyond the upper limits we may conceive of forms of society, Utopian or otherwise, which would be possible only by the continued biological evolution of the human species. From the evolutionary standpoint, then, the lower limits are those which we have already passed, while the upper limits are those which we are approaching—if it be assumed that biological development of human structure is still in progress.* Between the lower and upper limits is a margin within which variability of human institutions is a function of social rather than of biological change. If the margin be conceived as narrow, an interest in the biological differences between groups of men necessarily results. Hopes of human progress will find expression in various efforts for eugenic reform. If the margin be conceived as wide, changes in social organization will receive attention as means of bringing about desired improvements in society. The differences in the views of biological and cultural determinists are fundamentally differences in belief as to the extent of the social changes which are possible within the existing biological limitations of the race.

It would not be diffcult to multiply illustrations of the lower biological limits. In an entertaining little booklet,† Clarence Day, Jr., examines the biological possibilities and predispositions of mankind with the objectivity of "a man from Mars". It is due to the fact that we are *simians,* we are told, that hopes of permanent peace are possible of attainment. Simians do not really like to fight. If they did it would be unnecessary to lead us into battle with idealistic phrases concerning honor, patriotism or liberty. In a super-cat world, the carnage would be its own justification. Man, the civilized simian, feels little repression of instinct at limitations upon his "right" to fight, but let anyone at his peril re-

*A hypothesis which Conklin and other biologists have denied.
†*This Simian World.*

strain man's "right" to talk! Or suppose that a race of super-ants held sway over the larger affairs of earth. Unremitting toil would then be substantially the sole response to stimuli.

Language offers another illustration. Doubt appears to exist among anthropologists whether our cousins, the Neanderthal men, were able to communicate by a spoken language. If not, society in forms characteristic of peoples now living was *a priori* impossible among the Neanderthalers. It is at least conceivable, in spite of their simian origin, that these people might have attained a high degree of intelligence, without developing language or the possibility of modes of social life characteristic of *Homo sapiens*. Such a development is difficult for modern man to conceive only because in his own evolution it was the factors that we call "social" that appear to have been most favored in the process of selection.

Still another illustration in the form of a problem of more limited application concerns the future racial composition of the United States. Stated briefly, the problem is whether there exists a biological tendency toward physical and mental morbidity and toward sterility in racial hybrids. Interest in this question was stimulated by a paper presented at the Second International Congress of Eugenics by a Norwegian scientist, Jon Alfred Mjoen.* Dr. Mjoen presented the results of experimental hybridization between "distant races" of rabbits, in the course of which progressive deterioration was observed. "The sexual instinct has for some of the individuals in the fifth generation almost disappeared and in the case of others the young ones die immediately after birth." He contends that these experiments substantiate a similar tendency toward racial decay in the case of human hybridization between Lap and Nordic blood in Norway.

The evidence presented by Professor Walter F. Wilcox† that the negro population in the United States is not sustaining itself in numbers by reproduction in any section except the rural south, would be at least partially explained by proof of Dr. Mjoen's hypothesis. For it is only in the rural south, speaking in a broad way, that the American negro has remained free from white intermixture.

The difficulties of establishing or disproving this thesis would be many. Professor Franz Boaz has found an increased fertility in half-blood Indians.‡ Charles B. Davenport found that some hybrids between blacks and whites in Bermuda and Jamaica showed exceptionally high fecundity.§ But in both of these cases the results are mainly for the first generation, in which, according to Mjoen, no decrease in number of offspring, and an increase in height and weight, are to be expected.

Without holding any brief for the theory described, it is desired here merely to point out that the ethnic and social characteristics of the human beings who inhabit the earth a few thousands of years hence will depend in no small degree upon the existence or non-existence of such a biological principle. The integrating tendencies of the modern world, if unchecked, may be expected to accelerate racial intermixture and approach the production of a uniform hybrid racial stock, together with a uniform cultural type. "If in the past," says Conklin, "God made of one blood all nations of men, it is certain that at present there is being made from all nations one blood."|| But if hybrids between the main racial

**Harmonic and Disharmonic Race Crossings*, See *Eugenics in Race and State*, Vol. II, Scientific Papers of the Second International Congress of Eugenics, held in New York, September 22-28, 1921, pp. 41-61.

†*Distribution and Increase of Negroes in the United States*, in *Eugenics in Race and State*, Vol. II, pp. 166-174.

‡*Popular Science Monthly*, October, 1894.

§*Heredity of Skin Color in Negro-White Crosses*, p. 46.

||*Direction of Human Evolution*, p. 47.

stocks tend toward extinction, one or another different results would follow.

In the United States, as the pure negro blood tended to vanish, the negro population would become increasingly of mixed blood, would reach a maximum number, and would then decrease by sterility on one side, and on the other by the breeding out of negroid characters through further mixtures with the white.* A substantially pure white population would ultimately result.

An alternative outcome would be the preservation of a race of pure blooded negroes, protected by the vigor of their negroid characteristics. This race would suffer losses to the vanishing mixed-blood group, but to the same degree that these losses occurred, the tendency toward racial purity would be strengthened by selection among those who remained uncontaminated by white blood. Preservation of the corresponding culture type might be expected for the same reason, though perhaps to a less degree. That is, those variants from the black stock whose intelligence and temperament inclined them favorably toward the culture of the white stock, and *vice versa*, would be in the main the same individuals whose blood would be lost to the black by intermixture with the white.

Enough has been said of this question to show that a biological law of the kind suggested by Dr. Mjoen's studies *may possibly* be setting a lower limit to the possibilities of racial and cultural amalgamation between two peoples so diverse as the two major races in the United States.

The location of the upper biological limits upon society are more difficult to establish than some, at least, of the lower limits. New or non-existent types of human beings would not have to be evolved in order to extend the upper limits and bring higher forms of society—now wholly impossible—within the range of practicability. A shifting of the median or the mode might suffice. Or so the Eugenist contends. He would ask for nothing more than that the *protocracy* of this generation (to employ Giddings' term) might become the parents of the next. Can society continue to "advance" without such a modal shift in the direction of the more highly endowed individuals? Can it avoid retrogression if a modal shift in the opposite direction is not stopped? These questions are still being answered on the basis of temperament and emotion. It is to be hoped that biological and sociological science may between them some day accumulate a sufficient body of *facts*, so that the biological limits which condition society may be accurately determined.

Cf HARRY H. LAUGHLIN, *Race Assimilation by the Pure Sire Method, Journal of Heredity*, July-August, 1920.

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Alaska Titanic

SPIKES OF TWO POULARD VARIETIES OF WHEAT

FIGURE 30. These varieties are known as "composite" or "many-headed" wheat. In this type the rachis is branched or composite, but only one spikelet is borne at each rachis node. The variation described in this paper has supernumerary spikelets, and differs from the Poulard varieties by having a single unbranched rachis, and by the occurrence at many nodes of more than one spikelet at a single node of the rachis.

SUPERNUMERARY SPIKELETS IN MINDUM WHEAT*

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PRACTICALLY all wheat species and varieties have a single simple or unbranched rachis. Exceptions occasionally are found in Black Winter Emmer, *Triticum dicoccum*, but are more commonly observed among the poulard wheats, *T. turgidum*, of which certain varieties normally have composite heads, due to branching of the rachis. Ball and Leighty[1]† and others have described the poulard variety, *Alaska*, known also as "Seven-headed," "Egyptian," "Mummy Wheat," etc., spikes of which are shown in Figure 30. Alaska is probably the best known variety of the composite-headed wheats in the United States.

In their discussion of the inflorescence of wheat, Clark, Martin and Ball[2] state that the spikelets are borne singly on alternate sides of a zigzag, flattened, channelled, jointed rachis, parallel to its flat surface. Meunissier[7] and Percival,[8] however, have published photographs and described variations in the common wheats in which more than one spikelet is found at a rachis node. They state that the variations they observed are partially heritable, but no data are presented by these authors.

History and Description

While rogueing the varietal plats of spring wheat at the Akron, Colorado, Field Station of the United States Department of Agriculture in 1922, the writer observed in the plats of the durum variety, Mindum, C. I. No. 5296,‡ two plants, each bearing a single head differing widely from the usual type of that variety. After discovering these plants, strict search was made for others in the four fiftieth-acre plats of the Mindum variety, but no more were found.

The basal portion of the variant spikes found in Mindum was noticeably widened, which gave them an appearance similar to that of the composite-headed wheats. When the variant spikes were examined closely, however, it was seen that the rachis of both spikes was of the usual unbranched type. The increased width of the spikes was caused by the occurrence of one or two supernumerary or additional spikelets at several nodes in the lower part of the rachis. The occurrence of more than one spikelet at a node was irregular, but in general was confined entirely to the lower half of the spikes. None appeared in the upper half of either spike. When additional spikelets occurred they were borne side by side, and not one above another.

The heads from these two plants were similar to each other in all respects. Heads of the variant type are shown in Figure 31. Typical heads of Mindum are shown in Figure 32. The spikelets of the variant heads shown in Figure 33 resembled closely those of the Mindum variety as described by Clark, Martin and Ball[2]. The glumes were yellow and glabrous, the awns long and white, and the kernels much like the white kernels of Mindum. The variant heads, however, differed greatly in general ap-

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†For numbered references see "Literature Cited" at the end of this article.

‡Cereal Investigations accession number.

WHEAT SPIKES SHOWING SUPERNUMERARY SPIKELETS

FIGURE 31. Compare these spikes with those of the Poulard varieties (Figure 30). Though the external appearance is somewhat similar the two types are entirely different in structure. These spikes have more than one spikelet at many nodes in the lower part of the rachis, whereas normally there is only one spikelet at each node. This variant form was discovered in the Durum variety Mindum C. I. 5296.

TYPICAL HEADS OF MINDUM DURUM WHEAT

FIGURE 32. This variety was first grown by the Minnesota Agricultural Experiment Station at St. Paul, in 1896. It has proven somewhat resistant to the black stem rust of wheat, and is grown commercially to some extent.

pearance from normal heads of Mindum, in which they were discovered,

The seed of the Mindum variety in which these variant heads appeared was received at the Akron Field Station in the spring of 1922 from Mr. Ralph W. Smith, representative of the Office of Cereal Investigations at the Dickinson Substation, Dickinson, North Dakota. The two variant heads were found in 1922, the first year the wheat was grown at Akron. While close search was made in 1923, no more heads of this variant type were found in the several plats of the variety.

In their Classification of American Wheat Varieties, Clark, Martin and Ball[2] present the following history of the Mindum variety:

> "Mindum was first grown in 1896 in a centgener nursery at University Farm, St. Paul, Minn., as a selection from wheat which was called "Hedgerow," by the Minnesota station. The statement was made in the Minnesota accession book that it was a head selection from a field of common wheat. It proved to be a rust-resistant strain at University Farm, and was tested at the substations. It was a high-yielding wheat in experiments conducted at the Northwest substation at Crookston, Minn., during the years 1913 to 1916. The variety was named Mindum (a contraction of Minnesota durum) in 1918, for the purpose of distinguishing it from the commercial Arnautka."

The wheat is now grown to some extent commercially in Minnesota.

Experimental Data

Unusual forms found in wheat usually do not prove heritable, but it was decided to test the heritability of this variation. On May 12, 1923, fifteen kernels were taken from each of the two spikes and sown in a head row in the plant breeding garden at Akron, Colorado. The kernels were spaced approximately two inches apart in the rows. The plants emerged on May 18. The first heads appeared in Row 1 on July 12, and the plants were fully headed on July 22. In Row 2 the plants started heading on July 9 and had fully headed on July 18.

Weather conditions during the 1923 season at Akron were adverse for late-sown spring wheat. As a result of dry weather and a severe epidemic of stem rust, the plants did not reach a maximum development. The heads of two of the thirty plants were destroyed by locusts, and only fifty-one heads were produced in the two rows.

Although the experiments were affected by several unfavorable conditions all of the fifty-one heads contained the supernumerary spikelets characteristic of the parental heads. The number of nodes at which more than one spikelet appeared varied in the heads from the different plants as well as in those on the same plant. The heads from one row bore the supernumerary spikelets more abundantly than those from the other row. In several heads three complete spikelets were produced at a single node of the rachis. This condition caused considerable crowding and the spikelets stood out at a noticeable angle from the rachis.

Discussion

No report seems to have been made previously of the occurrence in durum wheat of heads having more than one spikelet to the node of the rachis. Meunissier[7] and others have observed variations of a similar nature in common wheats, but no cause for their occurrence has been advanced.

The cause of this peculiar variation in Mindum wheat is not known. Natural crosses are known to occur in wheat, and at first it was thought that this variation might have resulted from a natural cross between durum wheat and either Alaska wheat or emmer, in both of which branched heads occur. In controlled crosses of Alaska with durum, and emmer with durum, that have been made, however, branching of the rachis was produced in the first hybrid generation and supernumerary spikelets have not been observed. In the second hybrid generation segregation occurs. The variation observed in Mindum was characterized, however, by a duplication of spikelets at a node of the rachis, and not by a branching of the rachis.

SPIKELETS OF MINDUM WHEAT

FIGURE 33. Segments of the rachis showing supernumerary spikelets which characterize the variant type found growing in the Mindum wheat at Akron, Colorado, in 1922. Top—Typical spikelets of Mindum wheat. Center—Showing two complete spikelets borne at a rachis node. Bottom —Three complete spikelets borne at a single node.

If the variation found in Mindum had originated by hybridization, segregation would have been expected in the plants grown at Akron in 1923. Although the number of individuals grown in 1923 was small it was sufficient to have permitted some segregation to have occurred. Since it did not occur, and since the type of head is not that obtained in crosses in which wheats with branched heads are used, it must be concluded that this variation is not the result of hybridization.

Origin by Mutation

Various mutations have been reported in agricultural crops, and a few variant forms have been observed in wheat. Supernumerary spikelets were observed in common wheat by Meunissier[7] and Percival,[8] and are believed by them to be partially heritable. Cutler[4] reports the occurrence of dwarf plants in Marquis wheat, and similar forms were observed by Richardson[9] and Farrer[5] in other varieties. Apparently Cutler attributes the forms observed by him to the peculiar Indian ancestor of the Marquis wheat. Heritable duplications in the floral parts in several of our crop plants have been observed. The occurrence of a peculiar multiflorous variation in Burt oats is described by Coffman and Quisenberry[3] and is thought by them to have resulted more probably from mutation than from hybridization. Wiggans[10] has mentioned a peculiar variation in the spike of barley, and Gernert[6] described as a new species of *Zea mays* a variation which he calls "ramosa" because of its peculiar floral parts. It is the belief of the writer, therefore, that the heads of Mindum wheat with supernumerary spikelets, described in this paper, originated by mutation.

Summary

Two variant plants, each bearing a single spike containing supernumerary spikelets, were discovered in Mindum durum wheat at Akron, Colorado, in 1922. Seed of these variants was sown and twenty-eight progeny plants were produced. These bore fifty-one heads, all of which contained supernumerary spikelets similar to those in the abnormal parental heads. In all the progeny, as in the parental heads, the supernumerary spikelets were found only in the lower portion of the heads. The cause for the occurrence of this variation is unknown. Variations similar in nature have occurred in other cereals, and it is believed more logical at this time to attribute the occurrence of this variant type in Mindum durum wheat to mutation rather than to natural crossing.

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